SMARTPHONE TECHNOLOGY AND TEXT MESSAGING TO PROMOTE WEIGHT LOSS IN YOUNG ADULTS

By:

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ABSTRACT

Background: Overweight and obesity are a major public health problem for young adults in the United States. Current research suggests that young adults gain weight due to poor food choices, convenience eating, increases in alcohol consumption, decreases in fruit and vegetable consumption, and decreased physical activity. Behavioral interventions that can be easily integrated into the lives of young adults are needed. Utilizing a technology like Smartphone applications and text messaging may provide a good platform for delivering an intervention to this population.

Methods: This study was a two-part study, beginning with a focus group study followed by a randomized controlled trial to test the effectiveness of a Smartphone application + text messaging on weight. Participants in both studies were young adults aged 18-25 years. Participants were conveniently sampled from an area in and around a college campus. Focus group results were analyzed using a process of thematic analysis. Randomized controlled trial results were analyzed utilizing Wilcoxin rank-sum tests and chi-squared or Fisher's Exact test for group differences in baseline characteristics. A completers analysis was performed using generalized linear models, which were used to test for group differences, time effects, and interactions between group*time.

Results: Participants from the focus group confirmed that utilizing a Smartphone application and text messaging would be of interest to them in a weight loss study. The randomized controlled trial contained 62 participants, 71% female and 33.8% Asian. Participants randomized to the intervention group lost significantly more weight ($p=0.026$), significantly reduced their body mass index ($p<0.01$), and significantly

reduced their waist circumference ($p<0.01$) when compared to participants in the control group.

Conclusions: Smartphone applications are easily integrated into the lives of young adults. When used as part of a behavioral intervention, Smartphone applications plus text messaging can be a successful tool for helping overweight and obese young adults lose weight.

Advisor: Jerilyn Allen RN, ScD, FAAN

DEDICATION

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DISSERTATION

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CHAPTER ONE: INTRODUCTION

BACKGROUND

Overweight and obesity are a major public health concern in the United States. Overweight is defined as a person having a body mass index (BMI) ≥ 25kg/m2 and obesity is defined as a person having a BMI ≥ 30kg/m2. Since the late 1980's and early 1990's there has been a significant increase in the prevalence of overweight and obesity among adults in the United States. Among men, obesity rates have increased between 1988-1994 and 2009-2010 in Non-Hispanic whites by 15.9% and in Non-Hispanic blacks by 17.7%. (1) Among women, rates have increased over the 22 years by 9.3% in Non-Hispanic whites and 20.1% in Non-Hispanic blacks. (1) Abdominal obesity, defined as a waist circumference > 102cm for men and > 88cm for women, has also increased from 1999-2008. (2) Even among young women, aged 20-39 years, there has been a significant increase in waist circumference from 1999-2008 and although not significant (p=0.06) there has also been an increase in waist circumference in young men. (2) Although rates of obesity have stabilized, significant increases in waist circumference were still seen from 2003-2012 for all adults (p=0.02). (3)

In the 2011-2012 National Health and Nutrition Examination Survey (NHANES) estimated that 60.3% of US adults aged 20-39 years had a BMI ≥ 25. (4) There are certain subgroups of the population that tend to suffer more from overweight and obesity. Non-Hispanic blacks are reported to have an overweight and obesity rate of 71.9% for those aged 20-39 years. (4) Non-Hispanic black women have the highest rate for those aged 20-39 years with 80.0% being overweight or obese. (4)

Studies that have examined college-aged individuals, specifically freshman or first-year students have shown that many tend to gain weight during this time. In a recent meta-analysis, it was concluded that college students gain a significant amount of weight, an average gain of 1.55kg. (5) It was also concluded that college students gain a significant amount of fat, equaling 1.17% fat increase. (5) The study also concluded that weight gain in the first year of college was significantly less (mean= 1.52kg) than in the remaining years (mean= 2.54kg). (5) Of the 49 studies examined in the analysis, it is important to note that 79.3% of the participants were Caucasian and 66.6% were female, thus leaving out minority groups that disproportionately suffer from overweight and obesity. (5)

Overweight and obesity have been linked to many significant health concerns. An increase in BMI has been linked to a greater risk for hypertension, type II diabetes, coronary artery disease and stroke, osteoarthritis, and certain types of cancer. (6) Additionally, obesity has been associated with greater risk for mortality compared to those in the normal weight category (BMI 18.5-24.99). (7) Studies have also shown that abdominal obesity, independent of BMI, is associated with health concerns such as hypertension. (2)

LITERATURE REVIEW

Overweight and obesity are a major public health concern for young adults in the United States. Young adults are at an increased risk of being overweight and obese, and may begin to gain weight once they enter a college environment. (5) There is a need for

studies that target young adults and focus on intervention strategies that can easily be integrated into their lives so that successful weight loss can be achieved and sustained.

In the past ten years, the use of Smartphone technology has greatly increased in the United States. The addition of Smartphone technology to society has given young adults access to resources including applications, activity tracking capabilities, and real-time feedback mechanisms. The current estimate is that 85% of young adults aged 18-29 own a Smartphone and of those that do own a Smartphone, 100% use it to send and receive text messages, 97% use it to browse the internet, and 77% use it to look up health information. (8) In addition to this technology being integrated into the lives of young adults, many healthcare professionals are also now using this type of technology. (9) A recent study reported that between 85-90% of medical professionals use this type of technology in a clinical setting. (9) The number of applications for health has now reached approximately 17,000 and this number is expected to continue growing. (10)

Technology assisted interventions for weight loss have been successfully integrated into the lives of patients. (11). Multiple studies have reported significant weight loss, reduced BMI, reduced fat mass, and increased physical activity in participants using Smartphone technology verses those who were not. (11) Many of these studies utilized multiple forms of technology, including Smartphone applications, accelerometers, and scales. A study by Martin et al (2014) utilized all three forms of the technology previously mentioned and found significantly greater weight loss in the intervention group compared to a group who received education materials only for a 12-week period. (12) One study utilized a commercially available free Smartphone application for weight loss. Findings suggested that there was no difference between

weight at 6 months between intervention and control. However, greater than 30% of participants were lost to follow-up and greater than 10% of the control group accessed and used the application during the trial. The trial participants reported high satisfaction with application usage and the authors reported that the individual who accessed the application the most, lost the most weight. (13)

Very few studies utilizing Smartphone technology have focused solely on the young adult population. A recent meta-analysis was conducted focusing on studies that targeted weight, physical activity, and nutrition in college students from 1970-2014. Of the 41 studies identified by the authors, only 9 included the use of online technology. (14) None of the 9 studies that implemented online interventions utilized any form of Smartphone technology. (14) One study conducted in 2013 that was not included in the meta-analysis utilized a social media platform, Facebook, and text messaging in college students. This study found significantly greater weight loss in the intervention arms when compared to control. (15) One unique feature of this study was an additional intervention component that included personalized feedback through text messaging.

Text messaging, also known as short messaging service or SMS, has been widely used in studies to help participants change behaviors. (16) In a recent review, 14 randomized or quasi-experimental studies were identified where SMS was the primary intervention method used for behavior change related to weight loss, including physical activity and diet. (17) There were many differences in SMS interventions, frequency of messages varied from once a month to five times per day, delivery times varied from morning to evening, and differences in terms of automated vs. non-automated messages were apparent. Of the studies identified in the review, 80% reported a statistically

significant effect for weight loss specific variables, including physical activity, weight, or diet. (17) Six of the 14 studies delivered SMS at least one time per day, of those 6 studies, five demonstrated significant improvements in weight loss behaviors. (17) Very few studies had a mean age <30 years. One study by Prestwich et al (2010), mean age 23 years, reported that the group who received goal reminders via SMS lost significantly more weight over 4 weeks compared with control. (18) A study conducted in adolescents, aged 16-19 years, reported that moderate physical activity increased across all groups in the study, with the intervention group receiving one SMS per day and the control receiving one SMS per week. (19) Another study conducted in women between the ages of 18-30 years sent automated daily messages to participants in the intervention group, but found no significant improvement in BMI or sugar-sweetened beverage consumption compared to control. (20) A study conducted in a university setting by Hebden et al (2013), mean age 23 years, gave intervention participants access to Smartphone applications and sent 4 SMS per week, reported weight loss, an increase in vegetable consumption and a decrease in sugar-sweetened beverage consumption, but no significant differences between intervention and control. (21)

Overall, very few studies have been conducted in young adults that utilize text messaging and/or Smartphone applications for weight loss. However, the literature shows that these types of interventions can be successful in leading to weight loss and other improvements in weight related outcomes.

SIGNIFICANCE

This study is important because it focused on young adults who are at an increased risk for weight gain. This study utilizes a type of growing technology that fits an individual's lifestyle and provides real-time feedback and the ability for self-monitoring any time of the day. Young adults who owned a Smartphone between the ages of 18-25 years, who were overweight or obese with a BMI ranging from 25-40kg/m^2 were identified. Among these young adults, a randomized controlled trial was conducted to test whether an intervention that combined Smartphone monitoring via an application and individualized text messages would lead to weight loss. The study is significant because it rigorously tested a unique intervention that combined Smartphone technology and text messaging that had not been previously tested in this population. This study is also significant due to the large representation of minority groups, 13% African American, 34% Asian, and 14.5% others which included Hispanic.

STUDY PURPOSE

The purpose of this study was to examine the efficacy of an intervention combining a Smartphone application for weight loss with health coach personalized text messaging on weight loss in a group of young adults. This study specifically 1) examined the acceptability of the usage of Smartphone applications and text messaging for weight loss and 2) tests the effect of the use of a Smartphone application with personalized text messaging on weight loss in young adults.

SPECIFIC AIMS

Among young adults, aged 18-25, who were interested in weight loss:

Aim 1. To explore a young adult's perspective on nutrition, exercise, and technology for weight loss in order to design a randomized controlled trial.

Aim 2: To determine if young adults in a Smartphone + health coach group will have a significantly greater weight loss compared to those in a control group.

a. Hypothesis 1.1: Participants using a Smartphone application + health coach will have a significantly greater decrease in weight over a three-month period as compared to participants in the control group.

Aim 3: To determine if young adults in a Smartphone + health coach group will have a significantly greater increase in total physical activity performed compared to those in a control group.

a. Hypothesis 2.1: Participants in the Smartphone + health coach group will have a significantly greater increase in total physical activity performed over a three-month period as compared to participants in the control group.

Aim 4: To determine if young adults in a Smartphone + health coach group will have a significantly greater increase in healthy eating habits compared to those in a control group.

a. Hypothesis 3.1: Young adults in the Smartphone + health coach group will consume significantly more fruit servings as compared to participants in the control group.

b. Hypothesis 3.2: Young adults in the Smartphone + health coach group will consumes significantly more vegetable servings as compared to participants in the control group.

Aim 5: To determine if young adults in a Smartphone + health coach group will have a significantly greater increase in self-efficacy for healthy eating and physical activity compared to those in a control group

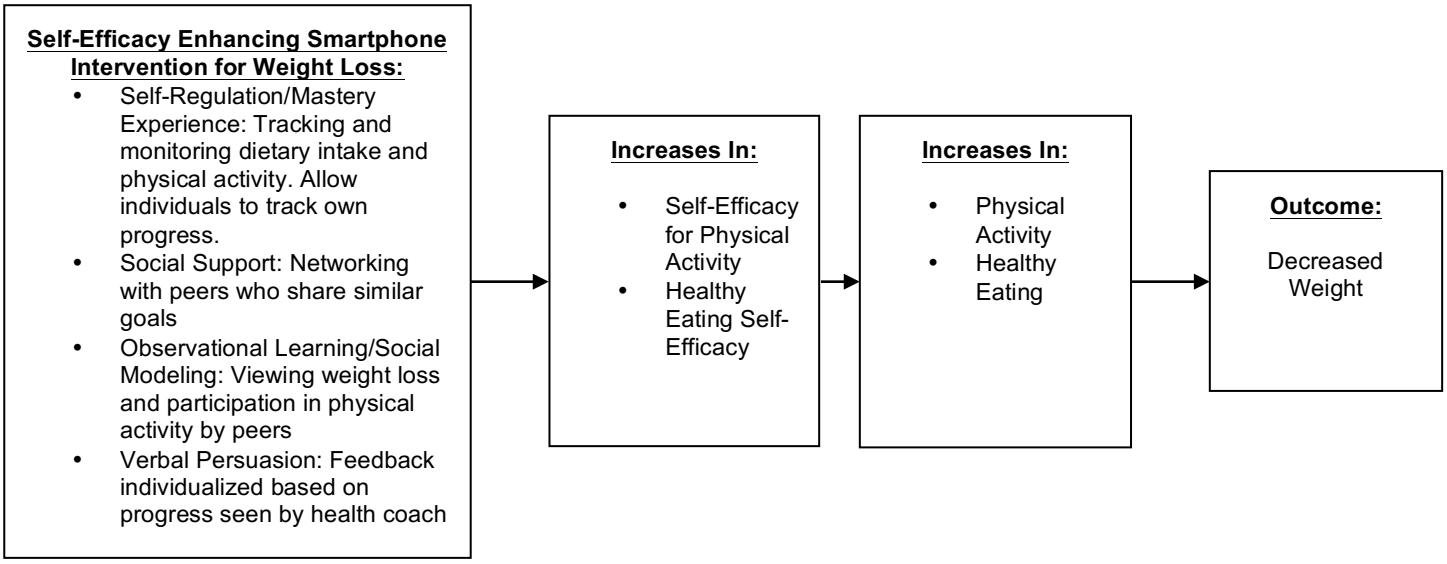
a. Hypothesis 4.1: Participants in the Smartphone + health coach group will have a significantly greater increase in healthy eating self-efficacy over a three-month period as compared to the participants in the control group.
b. Hypothesis 4.2: Participants in the Smartphone + health coach group will have a significantly greater increase in self-efficacy for physical activity over a three-month period as compared to the participants in the control group.

CONCEPTUAL FRAMEWORK

The Social Cognitive Theory states that personal factors, behavior patterns and the environment influence human behavior. (22) SCT has been used to guide internet-based studies with an outcome of weight loss or weight maintenance in children and adolescents. (20, 23) In the present study, social cognitive theory constructs was integrated in the following ways: the concept of self-regulation/mastery experience was encouraged through the use of the Smartphone application, in which the participant has the ability to track and self-monitor all foods consumed and all physical activity performed, as well as gain real-time feedback on caloric balance. The act of logging

provided instant feedback to the participant and logging can initiative positive behaviors (engaging in physical activity and health eating) and encourage participants to continue these behaviors. The participant could also enlist social support by utilizing the "friend feature" on the application. They can view the successes of their "friends" and receive inspiring messages. The health coach encouraged participants to engage in this feature. The concept of observational learning/social modeling is enhanced by the application, as the participant can view the weight loss and participation in physical activity of peers who share similar goals. Also, the concept of verbal persuasion is utilized through the health coach text messages to the participant, which provides the participant with individualized feedback. The concept of self-efficacy, which is the belief that oneself can accomplish a particular task, is a key concept for behavior change recognized by SCT. (22)

The literature reports strong evidence for the influence of healthy eating self-efficacy and self-efficacy for physical activity on weight loss. In one study, exercise self-efficacy was significantly increased in a group of college students working with a coach in a small group, which subsequently led to an overall decrease in BMI. (24) In another study, increases in self-efficacy were shown to be strongly correlated with weight loss in a 12-week behavioral intervention involving college students. (25) In the present study, it is hypothesized that healthy eating self-efficacy and self-efficacy for physical activity will increase more in the intervention group when compared to the control group over the 3 month study period. The Social Cognitive Theory defines ways to increase self-efficacy: mastery experience, social modeling and social support, and verbal persuasion. (22)



DISSERTATION ORGANIZATION

This dissertation is organized into five chapters. Chapter One is the introduction and provides the background and significance of the study. Key literature is reviewed and summarized to provide the basis for existing knowledge on the subject of the use of Smartphone applications and text messaging for weight loss.

Chapter Two (Manuscript One) is a review of the literature on existing usage of Smartphone applications for weight loss in adults.

Chapter Three (Manuscript Two) examines the acceptability of the usage of Smartphone applications and text messaging for weight loss in young adults. This focus group study data was used to design and implement an intervention utilizing this type of technology in a group of young adults.

Chapter Four (Manuscript Three) describes the findings from a randomized controlled trial conducted in young adults that tested the use of Smartphone applications and text messaging for weight loss. This manuscript specifically examines the use of this technology on weight, BMI, waist circumference, self-efficacy for healthy eating and physical activity, overall physical activity performed, and diet quality.

Chapter five summarizes the findings from manuscripts two and three. The implications of all findings from this research are discussed in this chapter and will provide a basis for key steps moving forward.

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CHAPTER TWO: MANUSCRIPT ONE

Mobile phone interventions to increase physical activity and reduce weight: a systematic review

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Abstract

Objective: This systematic review was conducted to determine user satisfaction and effectiveness of Smartphone applications and text messaging interventions to promote weight reduction and physical activity. **Methods**: Studies of Smartphone applications and text messaging interventions related to the cardiovascular risk factors of physical inactivity and overweight/obesity published between January 2005 and August 2010 were eligible. Studies related to disease management were excluded. Study characteristics and results were gathered and synthesized. **Results**: A total of 36 citations from CINAHL, EMBASE, MEDLINE, PsycINFO, and PubMed were identified; 7 articles were eligible for inclusion. The most frequent outcome measured in the studies was change in weight of participant (57%). More than half of the studies (71%) reported statistically significant results in at least one outcome of weight loss, physical activity, dietary intake, decreased body mass index, decreased waist circumference, sugar-sweetened beverage intake, screen time, and satisfaction or acceptability outcomes. **Conclusions**: All of the technology interventions that were supported by education or an additional intervention demonstrated a beneficial impact of text-messaging or smartphone application for reduction of physical inactivity and/or overweight/obesity. More rigorous trials that determine what parts of the technology or intervention are effective as well as establishment of cost-effectiveness are necessary for further evaluation of smartphone and text messaging interventions.

Keywords: Smartphone, mobile phone, cardiovascular disease, weight loss, physical inactivity

Background

Heart disease is the leading cause of death worldwide. In data published by the World Heath Organization, 17.5 million deaths were attributed to cardiovascular disease in 2005.[1] Interventions to aid in the prevention of heart disease are primarily targeted at reduction of modifiable risk factors. Modifiable risk factors include smoking, physical inactivity, obesity, poor nutrition, high blood pressure and abnormal blood lipid levels. Advancements in mobile phone technology have made it a desirable method for health promotion and disease prevention[2], including the prevention of heart disease by targeting specific risk factors.

Mobile phones are the primary mode of communication for the majority of the population worldwide. Between 2005 and 2010, the number of mobile phone subscribers rose from 2 billion to over 5 billion.[3] Many developed countries have reached subscriptions levels greater than 100%, while developing countries are not far behind with an expected 73% of the population subscribing at the end of 2010.[3] Mobile phone users are taking advantage of the capabilities of their device, such as short messaging service (SMS). SMS, also know as text-messaging, is a fast, cheap, and efficient way for people to communicate via mobile phone. Although rates of text-messaging differ by country and by gender and age within countries, a staggering rise in number of messages sent has been noted in the past three years.[3] In the United States, text messages sent monthly have risen from 7.2 billion in June of 2005 to 173.2 billion in June of 2010[4] with 72% of the adult population with a mobile phone sending and receiving text messages.[5]

Smartphone subscription has also been on the rise. Research suggests that smartphones will be the majority of the mobile devices used in the United States by the

end of 2011.[6] These devices are capable of providing an "inexpensive handheld computer that enables users to accomplish tasks anywhere, anytime."[7] There are thousands of applications related to health behavior and healthcare available to smartphone users.[7] With this technology at the consumers' fingertips, it allows researchers opportunities to create or utilize specific applications related to health promotion or disease prevention.

Multiple studies have reported benefits to using technology to enhance interventions for weight loss.[2,14] Specifically, studies report that the use of technology (web sites and email) is easily integrated into the lives of participants and allows for better flexibility for physicians and other healthcare providers when providing counseling and care to patients.[14] Favorable outcomes of face-to-face interventions have been enhanced by the use of the Internet and mobile phones.[2] However, there is limited reported evidence to the benefit of smartphone applications and text messaging programs to enhance behavioral modification related to weight loss and physical activity. There has not been a systematic review conducted on mobile phone technology specifically related to the cardiovascular disease risk factors of increased weight and physical inactivity. Therefore, this systematic review was conducted to determine user satisfaction and effectiveness of Smartphone applications and text messaging interventions in promoting weight reduction and physical activity.

Methods

Searching and Study Selection

The electronic databases searched were CINAHL, PubMed, EMBASE, MEDLINE, and PsycINFO. These databases were searched for studies conducted between January 2005 and August 2010. The search was limited to English-language publications. The

following text-word and MeSH terms were used: “coronary” or “heart” or “cardiovascular” and “Smartphone” or “mobile phone” or “cell phone” and “health promotion” or “health behavior.” The search was limited to quasi-experimental study designs and randomized controlled trials. A total of 223 abstracts were reviewed to determine if inclusion and exclusion criteria were met. Of the 223 abstracts, 36 studies were identified that needed further review (figure). Full-text articles were read for those needing further review and 7 studies were determined to meet review criteria. The major reasons for exclusion were as follows: the article focused on a factor other than weight loss or physical activity, such as smoking cessation, the article focused on management of a disease process (heart failure and diabetes) rather than prevention, or the research study did not use smartphone or mobile phone technology to deliver the intervention . For the purposes of this review, a text-messaging intervention is defined as an intervention delivered on a mobile phone, in which the participants receive an automated or personalized message via a short messaging service. A smartphone application intervention is defined as one that uses a program downloaded onto a participant’s mobile device that has numerous interfaces and specialized capabilities relating to it’s primary function.

Data Collection

Data from full text articles were extracted, including type of study, population, sample size, study methods, outcomes, measures and results.

Results

Sample sizes of the studies ranged from 36-927 participants. There were only two conducted studies that involved participants under the age of 18, and only one study that

was specifically focused on a pediatric population. None of the reported studies included participants over the age of 65. Eighty-six percent of the studies included both men and women, although only one study reported outcomes by sex. A majority (57%) of the studies were conducted outside of the United States.

A text-messaging intervention was implemented in 5 of the 7 studies[10-14], with the remaining two studies implementing a smartphone application intervention. The two studies that examined the effects of a Smartphone application examined the application as a stand-alone intervention[8, 9]. Three of the studies examined text messaging as the primary intervention but supported by education, in-person weigh-ins, or phone calls[10, 12, 14]. Two of the studies that examined text messaging examined the effects of text messages that were part of a larger intervention and were supportive to a specific weight management program[11, 13]. All of the studies in the review measured user satisfaction or acceptability of the intervention along with a variety of outcomes. The most frequently measured outcome was change in weight (57%) followed by physical activity (43%), change in body mass index (29%), change in waist circumference (29%), nutrition or diet adherence (29%), change in fat mass (14%), sugar sweetened beverage intake (14%), and screen time (14%). Five of the seven studies reported statistically significant results in at least one outcome. Length of studies ranged from four weeks to one year. Only two studies had multiple follow-up periods[12, 14].

The text messaging intervention studies varied with frequency of text messages sent during the intervention period. The minimum sent was one weekly while the maximum was an unlimited amount the participant could receive per day. Two studies were participant driven, meaning the participant sent a message and then received an

immediate response[10, 14]; the other studies did not allow participants to send messages. No consistent relationship was observed between amount of text messages received and change in outcomes. However, both studies that were participant driven reported statistically significant results in at least one outcome. The two studies that examined text messages as a supplemental piece to a larger intervention (weight loss program) reported significant outcomes for weight, BMI and waist circumference or acceptability for text messages to help with weight loss[11, 13]. The three studies that examined text messaging as the primary intervention, but with other materials (education, group meetings, etc) reported at least one significant outcome related to weight loss[10, 12, 14].

All of the studies measured user satisfaction and acceptability related to the intervention or program. Two studies examined differences in user satisfaction between programs[8 10]; neither study had significant differences in mobile phone group versus other group/s (web-based or paper diaries and control). Five studies presented percentages of participants who were satisfied with the intervention in terms of recommending to friends and family or helping reach weight goals. These five studies reported that greater than 50% of the participants were satisfied in one or both of these categories.

There were two studies that examined participant use of a Smartphone application.[8,9] The Smartphone applications both had the capabilities to record daily calorie intake and consumption, recording daily exercise, and show status of daily goals. The SmartDiet application had the capabilities to provide participants with a diet and exercise game, as well as an avatar that was altered according to the weight change of the participant.[9] The other Smartphone interface had the capabilities to report how team members were doing, show the results of the opposite team, send messages and

reminders, and answer questionnaires. This study reported no significant differences (other than satisfaction), while the SmartDiet application reported significant decreases in fat mass, weight and BMI.

Discussion

This systematic review revealed that text-messaging or smartphone applications are well accepted by participants and may provide beneficial effects on weight reduction, decreasing waist circumference, decreasing body mass index, decreasing fat mass, increasing physical activity, decreasing sugar-sweetened beverage intake, decreasing screen time, and encouraging healthier eating patterns. Of the four studies that measured the outcome of change in body weight, all reported a statistically significant decrease in weight in the group receiving the intervention. Also, all studies which measured waist circumference and body mass index reported significant results in these outcomes. Therefore, results show that weight, waist circumference and body mass index may be the outcomes researchers should focus on when developing programs or interventions using this type of technology.

The differences in the intervention strategies made comparisons across studies difficult. All of the interventions delivered in the reviewed studies differed on interfaces, mode of delivery of message, types of messages, dosage of intervention, and goals. Therefore, conclusions cannot be drawn about the type of technological intervention that is best designed to decrease the cardiovascular risk factors of weight and physical inactivity. It is unclear if technology interventions that act as stand-alone interventions are more effective than technology interventions that are combined with other tools for health behavior change, such as education or group sessions. However, it appears that

text-messaging interventions are effective when supported by other methods or are incorporated into an already existing program. There is no evidence to suggest that text messages as a stand-alone intervention are effective. Also, generalizability of results from the studies may be limited due to small sample sizes, homogenous samples, lack of reporting findings separate for males and females, and underrepresentation of ethnic minorities. Only one study reported a power calculation to determine appropriate sample size, therefore caution should be taken when interpreting the statistical results of these studies. Many studies did not mention the reliability and validity of the instruments they used to measure outcomes.

Another important factor to consider is the strength of the evidence reported from these studies. Not all of the studies were randomized controlled trials; introducing potential biases, including sample selection biases and instrumentation biases. Those that were randomized controlled trials also had limitations that should be noted when examining the reported results. For example, the studies conducted by Patrick et al and Shapiro et al, had other factors built into the intervention, aside from the technology being reviewed in this manuscript. These other factors included in person visits, calls from a healthcare provider, and mailings. Therefore, it cannot be determined which part/s of the intervention led to the reported outcomes. It should also be considered that high attrition[10] and differences in characteristics of participants who withdrew[14] were noted in some studies. Although randomized controlled trials provide the best evidence from which conclusions can be drawn, the limitations of each study should be carefully considered when doing so. Randomized controlled trials with large, heterogeneous

samples need to be conducted utilizing these intervention strategies alone in order to draw stronger conclusions based on the reported evidence.

Limitations

There were several limitations to this systematic review. The review was limited to studies in the past 5 years. Studies not referenced in PubMed, CINAHL, EMBASE, MEDLINE, or PsycINFO and unpublished studies were not identified, therefore the study is subject to publication bias. A major limitation to the generalizability and the ability to synthesize results is that 4 of the 7 studies were conducted outside of the United States. Therefore, studies focusing on particular cultures and using culture specific measurement tools cannot be generalized to populations in other countries.

There are also limitations in the use of technology for the cardiovascular risk factors of weight loss and physical inactivity that should be addressed. This type of technology often requires a patient or participant to have a mobile phone with text-messaging capabilities or a smartphone with a data plan. This limits generalizability to only those people who can afford the technology. Therefore, this type of intervention may not address the needs of certain low-income populations or those without mobile devices.

Another limitation to the use of this type of intervention is the lack of sufficient evidence on the effectiveness of mobile phone technology in children or the elderly. There is limited research in children and adolescents, as only two studies in this review enrolled participants under 18, and only one of these solely focused on children. Also, only one study reported enrolling participants up to the age of 65 and there is no research to date that examines people over the age of 65. Without further research, it is unknown

whether this type of intervention can be integrated into the lifestyles of the elderly or whether they would choose to engage in this type of technology. Therefore, the results of this review indicate that the positive effects of this technology on weight loss and physical activity should only be generalized to the middle-aged.

Implications for Future Research

The results of this systematic review raise several questions that should be answered in future research. How can smartphone and text messaging interventions benefit children and adolescents? Will text messaging and smartphone applications be effective interventions in the elderly? Is a text messaging intervention more or less beneficial than a smartphone application in reduction of weight and increasing physical activity? Would the combination of a smartphone and text-messaging be more beneficial than either intervention alone? Are smartphone interventions effective in low socioeconomic status subgroups? What are the long-term outcomes of smartphone and text messaging interventions? How can successful interventions be translated to populations? What is the cost-effectiveness of this type of intervention?

This innovative technology has many implications for cardiovascular nurses in future practice and research. A primary step for nurses is to explore common applications that are available for patient use. Cardiovascular nurses should be encouraged to inquire about patient use or interest in this type of technology and may also need to provide education related to applications.[15] In the future, nurses may be called upon to monitor patient progress and help provide feedback to patients. There are multiple avenues for nursing involvement with this type of technology, including becoming an integral part of answering the above questions for future research.

Conclusion

Most of the trials demonstrated a beneficial impact of text-messaging or smartphone application interventions for reduction of cardiovascular risk factors, including physical inactivity and overweight/obesity. There is a need for additional, rigorous trials with larger sample sizes across multiple populations with subgroup analyses to further develop this science.

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Figure 1: Summary of Search and Screening Results

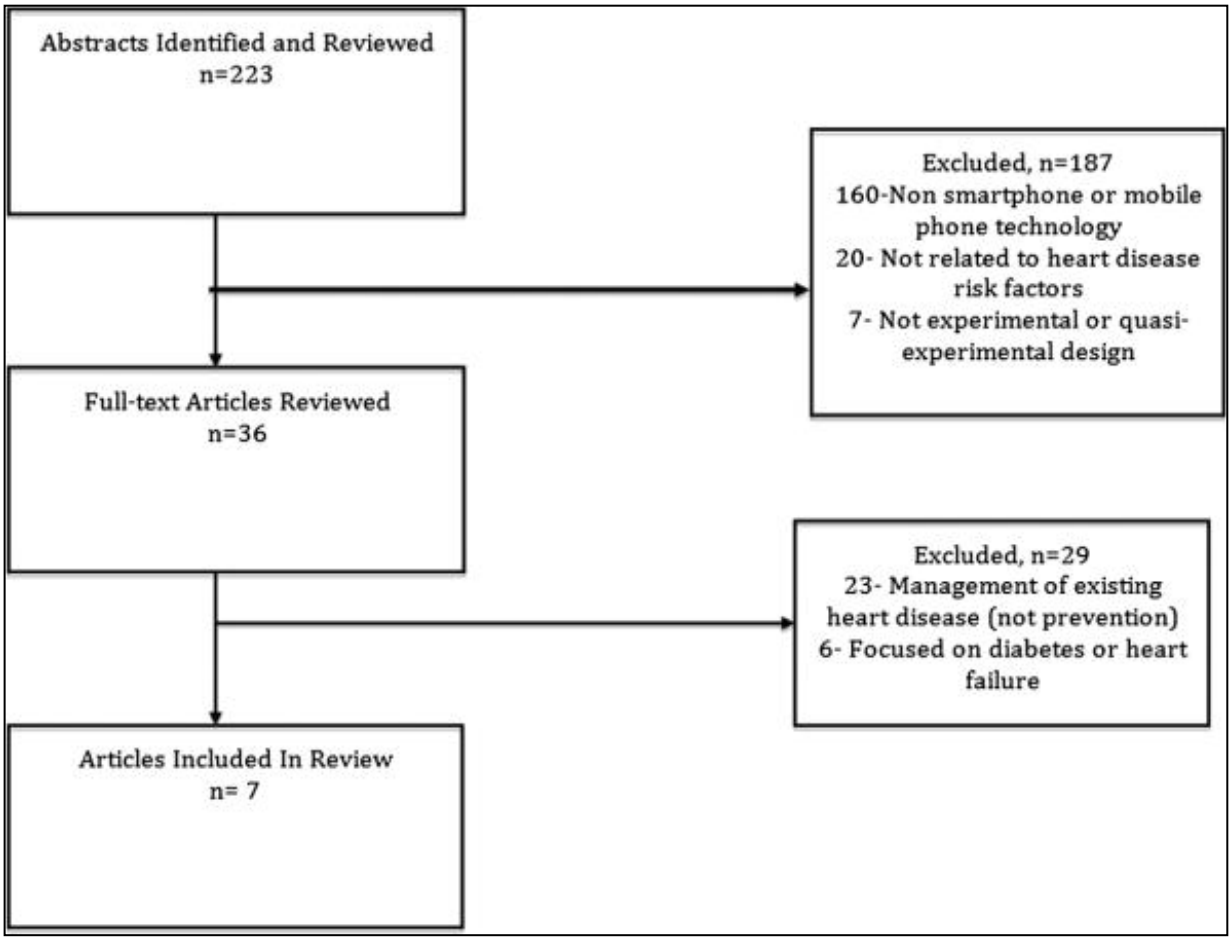

Table 1	Study Summary Table				
Citation (Year), Country	Population and Sample Size	Description of Intervention & Design of Study/Methods	Outcomes and Measures	Results	Study Limitations
Gasser et al., (2006), Switzerland	Healthy males and females, ages 14-50. N=40	Smartphone application – stand-alone intervention that was compared to a web-based application. Two groups (N=20 per group); participants were randomized, with age and gender controlled, to a group assigned to a Smartphone application or a group assigned to a web-based application. Subjects further randomized into two groups within each larger group, one being a team-based approach (team players) and the other being an individual approach (single players).	Primary outcome-usage and satisfaction of a mobile lifestyle coaching application compared to a traditional web application measured by an online survey using the QUIS Questionnaire for User Interaction Satisfaction, conducted at the end of the study. Secondary outcome- Physical activity and nutrition monitoring in mobile phone group at 4 weeks compared to web-based group measured by a self-monitoring diary.	Primary result: Mobile phone group had a more regular usage pattern than the web-based group. No significant difference in satisfaction between the mobile phone group and the web-based group, although the web interface was rated easier to learn than the Smartphone ($p<.003$). The Smartphone was rated significantly higher than the web interface for the question of whether it was stimulating ($p=.01$). Secondary result: No significant differences in physical activity goals or nutrition goals between the Smartphone users or web application users (either single users or team users). The only significant difference found was that women were more successful than men, 14 women in the above-average category compared to 5 men.	1. Small sample size 2. Study results confounded by age, gender, motivation for change, and lifestyle. 3. Short study duration (28 days).
Gerber et al., (2009), United States	African-American women, ages 30-65, BMI 30-50kg/m^2, in Chicago. N=95	Participants were all given access to text messaging systems on personal mobile phones or a mobile phone provided by the study. Over 230 general messages were created by researchers. In	Primary outcome: to determine feasibility of a mobile phone text messaging intervention. Measured by deliverability of text messages and usage of mobile phones by participants. Secondary outcome: to	Primary result: 70 of 73 (96%) women reported reading the text messages that were sent. 4500 text messages sent over 4 months, with 114 returning as undeliverable. “Most”	1. Women were enrolled into an on going weight loss trial, therefore satisfaction may have been high due to women already being motivated to lose weight.

		addition participants could create personalized messages (N=42). Participants were sent 3 general messages per week or were sent 2 general and 1 personal message per week.	determine satisfaction with a mobile phone text messaging intervention. Measured by study satisfaction questionnaire and telephone interview	participants demonstrated competence in accessing text messages. Secondary result: N=70. 54 of 68 (79%) indicated that text messages helped toward weight loss goals, 48 of 70 (69%) reported willingness to receive text messages during the week. Overall feedback from participants was "generally very positive."	2. Feasibility study- does not report any results on the effect of the text messaging on weight or physical activity. 3. Long-term usability and satisfaction is unknown due to short duration of the trial.
Haapala et al., (2009), Finland	Overweight (BMI=25-36kg/m^2) men and women, ages 25-44 recruited via newspaper advertisement and telephone screening. N=156	Participants randomized to a control group (N=63) or an experimental group (N=62). Control group received no intervention, experimental group was part of a mobile phone weight-loss program in which motivational and information text messages were received. Study lasted one year.	Primary outcome: Program effectiveness: short and long-term weight loss in experimental group, differences in weight loss and waist circumference between experimental and control group. Amount, frequency and type of use of the program and program satisfaction. Weight and waist circumference were measured at 0,3,6,9, and 12 months for experimental group and 0 and 12 months for control group. Survey of user's opinions and self-reported frequency of use measured use and satisfaction of program. Secondary outcome: Dietary habits, nutritional intake, physical activity, and dietary self-efficacy measured by self-	Primary result: Significant weight loss in the experimental group of 4.5kg at 12 months, control group with non-significant weight loss of 1.1kg at 12 months (significant difference between groups, p=.003). Waist circumference was significantly decreased in both groups, the largest decrease occurred in the experimental group (6.3cm) vs. the control group (2.4cm). A significant time effect for weight loss across the 3-month intervals and a significant time by group interaction at 12 months in favor of the experimental group was noted (p=.006). Participants rate the program a 7.8 out of 10 (scale: 4-10).	1. Intervention was designed to be support for self-directed dieters who were allowed to join another weight loss program. 2. Individuals who withdrew from the intervention group lost less weight in the first 3 months than those who stayed in the study. 3. Sample included 120 women and only 36 men. 4. The 3 monthly in person weigh-ins may have contributed to weight loss and outcomes in study 5. Information on physical activity and dietary habits were self-reported.

			reported dietary habits at 0, 6 and 12 months, question on leisure-time physical activity (seven-category scale), self-efficacy questionnaire with 10 items.	Frequency faded from 8 times per week to 3-4 times per week by 12 months. Secondary result: at 3 months, 83% of completers reported having made improvements to their diet. Physical activity increased in both groups on average from 2-3 times per month to 1 time per week ($p<.05$). Self-efficacy in dieting increased among those who had lost at least 5% of initial weight by 12 months ($p=.46$), but decreased among those who had gained weight or lost less than 5% of initial weight at 12 months ($p=.008$).	
Joo et al., (2007), Korea	Adult men and women from Korea recruited over a three month period. N=927	Subjects tested at baseline, then entered a 12 week anti-obesity program where they received random weekly SMS messages on behavior modification and weekly information brochures on exercise and diet (via post). At the end of the 12 week program, subjects were then tested again for all body measures and also given a questionnaire on satisfaction with the program.	Primary outcome: 1) Changes in body weight, waist circumference, and BMI at end of program measured by nurse at initial visit and 12 week visit. 2) Changes in blood pressure, total cholesterol, high-density lipoprotein (HDL), triglyceride and fasting glucose levels. Measured by nurse at initial visit and at 12 weeks. Secondary outcome: Satisfaction with the SMS intervention. Measured by questionnaire (8 questions) distributed after 12 week	Primary result: 534 subjects completed data collection with 433 subjects completing their weight control program. Mean weight reduction was 1.5kg, mean BMI reduction of 0.6kg/m^2, mean waist circumference reduction of 4.3cm, all significant ($p<.001$). Mean systolic blood pressure ($p<.05$), mean diastolic blood pressure, fasting glucose, triglyceride and HDL all reduced. Overall total cholesterol increased by 0.8mg/dL but was not	1. Intervention also included weekly mailings delivered via post on diet and physical activity, the text-message portion of the intervention was related to behavior modification only. 2. Short duration of intervention (12 weeks). 3. No control group for comparison 4. No way to determine if the text-messages were effective alone, or if the mailings by post were

			program	significant. Secondary result: (n=433) greater than 60% of subjects reported being satisfied with the SMS messages and agreed that they were helpful in weight reduction.	effective, or a combination of both.
Lee et al., (2010), Korea	Obese adult males and females recruited from an obesity clinic in Seoul, Korea. N=36	Intervention and control group. Intervention group: n=19, average age 28.2, patients received access to the SmartDiet mobile phone application. SmartDiet contains personalized nutrition information and a diet game which provides a game-style learning tool about controlling nutrition intake and exercise.	Primary outcome: testing the effectiveness of SmartDiet in acquiring dietary information, weight control and user satisfaction. Measured using a questionnaire administered at the end of the study. Secondary outcome: changes in weight, fat mass and BMI. Body composition measured at beginning of intervention and again at the end of the intervention using an analyzer called Inbody.	Primary result: 11 of 19 (58%) of intervention group agreed that the system was easy to use and contents were interesting. 13 of 19 (67%) would recommend the system to others. Only 8% of participants used the system every day. Secondary result: Fat mass (-1.2kg), weight (-1.9kg) and BMI (-0.8kg/m^2) were significantly decreased in the intervention group ($p<.05$). None of the measures were significantly decreased in the control group.	1. Small sample size 2. Short intervention (6 weeks), no long-term effects analyzed 3. Only 8% of participants followed the instructions of the interventionists to enter meals and physical activity daily. 4. Only participants who owned a SK Telecom mobile phone were included in the study.
Patrick et al., (2008), United States	Overweight (BMI≥25-39.9kg/m^2) adult men and women, 25-55 years old, recruited from the San Diego, CA community. N=65	Participants randomized to the intervention group, n=33 (receiving personalized text messages and picture messages, printed materials about weight control and brief monthly phone calls from a health counselor) or a usual care comparison group, n=32 (receiving monthly printed materials	Primary outcome: weight (kg) of participants at the end of the 16 week study. Weight (kg) assessed using a calibrated scale in the research offices at beginning and end of the study for both groups of participants Secondary outcome: satisfaction of the intervention measured with a survey of the intervention group.	Primary result: At the end of the 16 week study, the intervention group had lost significantly more weight (1.97kg) than the comparison group on average ($p=.02$). Secondary result: 22 of 24 (92%) of intervention participants stated they would recommend the intervention to friends and family.	1. Intervention included mailings via post and phone calls from a health counselor. 2. Small sample size, lack of diversity in sample characteristics. 3. Selected participants were all familiar with text messaging. 4. No long-term effects

		about weight control)			were examined; duration of intervention was 4 months.
Shapiro et al., (2008), United States	Children, of any weight, ages 5-13, recruited via pediatrician offices, schools, media advertisements and university listservs (University of North Carolina at Chapel Hill). N=58	Children randomized to one of three groups (SMS-text messaging group, paper diaries(PD) group or control) on a 1:1:1 basis (SMS:18, paper diaries:18, control:22)	Primary outcome: examine acceptability, attrition, adherence, and preliminary efficacy of mobile phone SMS (text messaging) for monitoring healthful behaviors in children. Acceptability measured with a 6 question Likert-scale survey; attrition measured by number who completed the entire 8 week program; adherence to self-monitoring analyzed with Wilcoxon rank-sum tests; preliminary efficacy measured using self-monitoring data and recall of targeted behaviors. Secondary outcome: monitoring of sugar-sweetened beverages, physical activity and screen time in children. Measured by self-monitoring of steps, sugar-sweetened beverages and screen time in the SMS group and the PD groups; self-reported recall of exercise, sugar-sweetened beverages and screen time in all three groups.	Primary result: no differences occurred in treatment acceptability except for likeliness of participating in such a study again, with parents in the control group being more likely to participate again. No significant differences occurred for attrition (likely due to small sample size), although substantially lower dropouts occurred in the SMS group (27.8%) compared to PD (61.1%) and control (50.0%). Adherence to self-monitoring was significantly higher ($p<.02$) in the SMS group (43%) compared to the PD group (19%). Secondary Result: SMS group showed significant reduction (signed rank -26.5, $p<.00$) in reported minutes of screen time when compared to PD and control groups. No significant differences between or within-group differences for exercise or sugar-sweetened beverage intake.	1. High attrition rate (only 31/58 completed) 2. Wide age range, children at different developmental stages 3. Self-report of all data. 4. Intervention group also participated in educational group sessions weekly. 5. Analysis not conducted to examine differences in outcomes based on age of child.

CHAPTER THREE: MANUSCRIPT TWO

Young Adults, Technology, and Weight Loss: A Focus Group Study

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Abstract

Overweight and obesity is a major concern in young adults. Technology has been integrated into many weight loss interventions, however little is known about the use of this technology in young adults. The purpose of this study was to explore through focus group sessions the opinions of young adults on the use of technology for weight loss. A total of 17 young adults, between 18-25 years of age, participated in three focus group sessions. Major results indicated that young adults have very little knowledge on the use of Smartphone technology for weight loss, but would like to use this type of technology to help them lose weight. Results also indicated that young adults struggle to make healthy food choices and have priorities that outweigh exercise, and they need support and guidance to make better decisions. In conclusion, young adults would be open to using Smartphone technology for weight loss, but also need feedback and guidance to help make healthy decisions.

Introduction

Overweight and obesity are a major concern for young adults in the United States. Young adults are at high risk of being overweight and obese and many begin to gain weight when they enter the college [1]. Studies have indicated that over 29% of young adult males and females, ages 20-34, are overweight or obese [2]. Among college freshman, many gain weight and continue to gain a significant amount of weight through their senior year [3]. Being overweight or obese can lead to complications later in life, such as diabetes, heart disease, sleep apnea, hypertension, elevated cholesterol, and even death [4-6].

Targeting college-aged individuals is important because college is a time where many lifestyle changes occur. Individuals can make their own food choices without influence of family and are subjected to many unhealthy habits, such as excessive snacking, unhealthy meal choices, and busy schedules leading to a decrease in time spent in physical activity. Qualitative studies have reported many factors related to weight gain in college students, including late night snacking, poor time management, stress eating, unhealthy food availability on campus, and lack of motivation [7-9]. There is a need to understand the types of interventions that would target college students who are interested in losing weight.

Existing literature reports that weight loss and other healthy habits can be achieved in young adults through various interventions. One study utilized Facebook with a personalized messaging component and saw significantly greater weight loss in this group vs. control (-2.4 kg vs. -0.24kg; $p<0.05$) [10]. Another program created an Internet based obesity prevention program designed for college students. The study reported an

increase in fruit and vegetable consumption and a decrease in stress compared to control, although they did not report any differences in exercise behavior or weight loss [11]. A study utilizing behavioral self-regulation reported significant weight loss in two groups receiving intervention (-6.6kg and -5.8kg, $p<0.001$). A study done by Gokee et al [12] tested two interventions in young adults. One group was assigned small changes (SC), in which changes in energy balance were small (200kcal/day). The second group was assigned large changes (LC) and was instructed to cut 500-1000 calories for daily intake. Weight changes were significantly different between the two groups at both 8 weeks (SC= −0.68±1.5 kg, LC= −3.2±2.5 kg, $p<0.001$) and 16 weeks (SC = −1.5±1.8 kg, LC= −3.5±3.1 kg, $p=0.006$) [12].

Incorporating technology into weight loss interventions has proven to be successful [13]. Smartphone technology can provide an individual with the ability to self-monitor diet and physical activity; receive feedback through the application or text messaging, and track progress towards goals. However, there is limited knowledge on the use of Smartphone technology for weight loss in young adults. In particular, the young adult's perspective on weight loss interventions that include a technology component has not been explored. When introducing new technology into interventions, it is critical to explore the opinion of the recipient. Therefore, the purpose of this study is to explore a young adult's perspective on nutrition, exercise, and technology for weight loss in order to design a randomized controlled trial.

Materials and Methods

This study used a qualitative exploratory design with focus group sessions to. It was approved by the Johns Hopkins Medical Institutional Review Board (IRB).

Young adults were recruited through posters and flyers posted around undergraduate and graduate campuses. A brief description was also posted on a university's Online Portal that students can view when logging into their email or other university related places. Word of mouth was also a popular recruitment method for the study. In order to participate, individuals had to be between the ages of 18-25 and had to be interested in weight loss. Young adults were not required to be overweight to be in the study, the goal was to gain the perspective of students who wanted to lose weight as well as those wanting to prevent weight gain.

Three focus group sessions were conducted between June 2013 and July 2013 by one researcher acting as the primary moderator. All focus groups were conducted in a casual environment in a private room of a campus library. The sessions each had one moderator and one note-taker. The note-taker's purpose was to watch for body language, facial expressions, and group reactions that could not be picked up on the tape recordings. The note taker and moderator met after each focus group meeting to discuss the notes that were taken. Each session lasted approximately one hour. All sessions included between 5-7 young adults. A total of 17 young adults were included in the three focus groups.

All sessions were tape-recorded. Three handheld tape recorders were used to record each session to ensure that all comments were recorded clearly and accurately. Demographic information, including age and race, was collected from each young adult at the beginning of each session. The moderator introduced herself and gave a brief explanation of the procedures to the focus group session along with a description of the focus group study. Written informed consent was obtained individually from young adults. Each young adult received a $25 gift card for his or her time.

A single discussion guide was created prior to the focus group meetings. This guide was meant to introduce topics to young adults with open-ended questions, as well as ask minimal directive questions (see Table 1). The group discussions focused on the following topics: overweight and obesity in young adults, diet and exercise habits, counseling strategies for weight loss or weight maintenance, the use of smartphone technology for weight loss, and texting/email feedback.

The moderator emphasized that all responses were welcomed and that no response was considered right or wrong. Quiet young adults were periodically asked if they had anything to share. Open-ended questions were used to begin each section of the discussion ("Tell me your thoughts on…"). The questions became more focused once the topic was introduced ("What specific topics would you want to discuss when talking with someone about weight loss…"). Table 1 describes the discussion guide and example questions from each topic.

Qualitative analysis of each focus group session was done using a process of thematic analysis. The process began with an initial read of the transcribed data and reading of the notes taken during the session. The analysis procedure consisted of multiple readings of the transcripts to identify key words or phrases. Coding began during the second read of the data. The relevant passages were coded initially using words from the young adults themselves. Subsequent readings of the transcripts and the passages coded in similar ways yielded categories of data describing the critical issues for young adults. Categories from each topic were combined to form themes, which provided a comprehensive view of the data.

Results

A total of 17 young adults were included in the three groups. Ages ranged from 18-25 years (mean=21 years). Across all focus groups 59% were female, 29% were African American, and 24% were white. In this study, 5 young adults wanted to maintain weight and 12 wanted to lose weight. The results across focus groups are organized by major themes with a general explanation of findings and exemplar quotes.

Theme: Freedom to choose often equals overweight and obesity

Across all focus groups, young adults expressed that overweight and obesity among young adults in the United States is a major issue. It was particularly clear that those who migrated to the United States in the past ten years saw overweight and obesity as a larger problem than those that had lived in the United States the majority of their lives. However, those that had been in the United States for most of their lives still identified weight as an increasing problem for young adults. Several potential causes of overweight and obesity among young adults were identified. The responsibility on the young adult to make healthy food choices was identified as the primary cause for weight gain in this population. Young adults expressed that having the ability to make choices, free of family influence, made it more difficult to choose healthy foods, especially because fast and convenient foods are so readily available. Also, for those in college, stress eating was identified as another major cause of overweight and obesity. Young adults expressed that attending classes, not sleeping, having to prioritize activities, and time management all lead to stress eating.

"It's a lot different than your life as a high school student, the stress and the new schedule of classes add to the pressure of how you eat and if you workout or not"

Alcohol was mentioned as another reason why many college students gain weight. The freedom of living alone, without parents, creates a situation in which individuals can consume alcohol freely. It is clear from the groups that many young adults engage in activities that involve alcohol both during the week and on the weekend.

"My roommate last year, he tried to lose weight and he would run like five miles a day but he would also drink…umm and then he would never really like lose that much weight because he drank too much"

Theme: Priorities are key

Young adults discussed what types of diet and physical activity habits they currently have and what influences those habits. They primarily expressed eating foods that are considered convenient, such as food from fast-food restaurants or food readily available in school cafeterias. The majority of young adults in the study were college students and explained that a lack of time to prepare meals was an important factor when making food decisions. Any free time they have, is spent doing more important tasks. These young adults tended to choose foods that were cheap because most were living on a budget, or they simply ate in the school cafeterias because they had a meal plan. Other competing priorities also get in the way of making healthy food choices. For example, choosing sleep over eating breakfast was a common occurrence in this population. The focus groups also highlighted that young adults lack knowledge about sugar-sweetened beverages and because they lack knowledge, they tend to consume very high amounts of these beverages.

"I feel like there is not much difference between the diet ones [soda] and the regular ones… I mean like the calories or whatever"

In terms of looking at the labels on sugar sweetened beverages, many young adults look at the label, but do not considerate it when making choices.

"I look at it but I guess I consider the food portion more than the beverage calorie portion, which doesn't make any sense, but just psychologically, like of course you're eating so of course you're going to consider those calories more than what you are drinking"

Activity levels in young adulthood depend on the individual, some increase activity and others decrease activity levels from high school. Many young adults, especially those in a college atmosphere have access to free workout facilities. However, their busy schedules and lack of sleep often compete with their drive to workout. Young adults emphasized the need and want to make exercise a social activity, if their friends do it, they will do it. However, like with diet, they have priorities that constantly compete with the ability to find time for physical activity such as sleep, studying, classes, and hanging out with friends.

Theme: Squash the rumors and talk with an expert.

Following the discussion of nutrition and physical activity habits, the young adults were asked about what information they would want to receive in a counseling session regarding diet and physical activity. All of the young adults identified diet as the most important part of any counseling session. Many young adults believe in the "80/20" theory, that weight loss is 80% diet and 20% physical activity. Knowing and understanding how much food they should be consuming was the greatest need, as most did not know how many calories they should be consuming per day to lose weight. Another major concern for young adults was weight maintenance and learning how to

keep weight off once they lose it. Young adults would also like help defining reasonable goals. They want help from an expert, and specifically want to learn how to work towards and achieve those goals by eliminating or getting through barriers. All young adults are exposed to many rumors about what works and what does not, as well as different fad diets. They would like knowledge about these types of diets and are interested in learning what is fact versus what is fiction. In terms of exercise, young adults expressed wanting to learn about types of exercise that are best for weight loss. They also wanted to learn about heart rates, calories burned during exercise, distance exercising, and how to pull all of this information together for use during their workouts.

Theme: Give me an app that does it all.

The major finding from the focus group discussion is that very little is known about what is available for use regarding Smartphones and applications for weight loss. Most of the young adults identified they would want an application that could track diet and exercise, track weight changes, had an easy way to enter foods and exercise, and could tell them the calories in restaurant foods.

"And I was thinking, if they could come up with an app that could umm give suggestions…like once you put your weight and age in, it would come up with at least how many walks you should have everyday, how much water you should drink everyday…"

"I kind of want it to have a calorie input thing, so that I can put how many calories I had that day"

Very few young adults knew that any of these features were available in current smartphone applications and when they heard that it was available, they were excited to

use this type of technology. The demand for an individualized program was high. Young adults wanted an application that is specific to their height, weight, gender, age, and weight loss goals. They also expressed interest in applications that have features that make tracking easy, such as a barcode scanner which could scan and auto-enter nutritional information from the foods they have consumed. When asked about a barcode scanner, a young adult replied, "that would be the coolest thing ever." The application should also contain a large database of restaurants and pre-made foods, so that young adults are not guessing on the amount of calories in foods, or relying on the restaurant menu to contain this information. The main finding from this section was that young adults wanted to use this type of technology, but did not realize that it was available for their use.

Theme: Personalize all messages, or risk being ignored

The final area assessed was the type of feedback young adults would want to receive from a health coach and what timing and mode of information delivery would be best (e.g. text message or email). Young adults stressed that any messages received, whether text messages or emails, must be individualized. They did not want to receive standard messages that are sent out to a group or automated from a system. Young adults expressed that they tend not to read generic messages; such as those they often receive from their university regarding safety concerns. Further, messages sent via text or email should be specific to a young adult's progress in a weight loss program, meaning that the health coach should pay close attention to areas where goals are being met and areas where improvements could be made.

"I think it would be good, as long as it wasn't generic, because if it was generic, I would probably not pay attention to it."

"I would want them to be pretty personal. Like if you saw that I was not doing something, then the message would be encouraging to what I was not doing, or something like that"

There is great variation in the number of messages that young adults expressed wanting when working with a health coach. Many young adults wanted at least one message per day, focused around meal times. Other young adults wanted only 1-2 messages per week, containing more summary information to guide their progress. The consensus was that once per week is a minimum for contact during a time when a young adult is trying to lose weight.

Information that should be contained in the messages included reminders to log foods or exercise into an application or diary. Also, encouragement to meet pre-established goals was important to young adults. One important factor to consider when sending a specific and individualized message is that young adults expressed not wanting any negative feedback sent to them. For example, if the healthcare provider or health coach is monitoring foods logged, young adults do not want to be "scolded" for eating something like a "cupcake." Messages should instead be framed as suggestions of healthy, nutritious foods to consume, and ways to possibly cut back on less nutritious foods. Receiving healthy recipes was also of great interest, as long as the recipes are simple and easy to follow. As a follow up to the more individualized messages, young adults were all interested in receiving a summary statement weekly, something to show how they ate overall for the week, how they exercised for the week, and any progress made for the week.

Discussion

The results of this study should inform the development of weight loss or weight maintenance interventions in young adults, particularly college students. Five themes were assessed during this study: 1) Freedom to choose often equals overweight and obesity, 2) Priorities are key, 3) Squash the rumors and talk with an expert, 4) Give me an app that does it all, and 5) Personalize messages or risk being ignored. There were several key take home messages related to the specifics of weight loss noted in this study (Table 2).

Regarding overweight and obesity, young adults expressed that this is a frequent problem in this population, which they attribute to newfound independence. This independence leads to making food and cooking decisions without the influence of family. Therefore, similar to other weight loss intervention studies in adults, a weight loss intervention for young adults should include a counseling session that includes tools for increasing knowledge and promoting good decision-making. This decision-making should include information on what makes up a healthy plate and how to make good choices even when faced with convenient, unhealthy foods. Young adults who are in college should receive counseling on the nutritional information of food choices provided in school cafeterias and how to make the best choice in a situation where there might not be a very healthy option. Also, as alcohol seems to play a role in weight gain in this population, counseling on the caloric intake of alcoholic drinks should be included along with strategies to consume less calories from alcohol. In a weight loss trial in young adults, a counseling session should also include time to learn the young adult's motivations for weight loss and priorities that will compete with the ability to lose

weight. Working through barriers and setting goals is important in this population and should be a major focus.

Young adults expressed that they knew that diet and physical activity were important, but that their habits were heavily influenced by time and cost. They had several competing priorities that inhibited their ability to choose nutritious foods so they resorted to fast and convenient foods or sometimes skipped meals like breakfast altogether. Despite knowing diet and physical activity were important, young adults may have a hard time determining, which foods to consume or avoid as well as which exercises are best. The lack of knowledge about SSB, nutrition fads, and breakfast consumption was evident. Therefore, a discussion and session on diet fads, SSB consumption, breakfast consumption, and more should be included when working with young adults who wish to lose weight.

As far as the authors are aware, this is the first focus group study to explore the use of smartphone technology for weight loss among young adults. What was evident from the focus group is that young adults lack awareness of the smartphone technology that exists to help with weight loss. Young adults were unaware of what types of weight loss applications are available and they showed a lot of interest in learning about them and using them in their future. Results also suggest that young adults may benefit from features such as using an application to set individualized calorie budgets and goals. Time to input food and exercise is an issue for young adults, however, may applications have features such as barcode scanners, restaurant menus, and custom exercises that make logging faster and easier. An application that has these features may be used more readily in the young adult population.

There was little consensus on the frequency of contact via text messages, but once per week was an agreed minimum and three times per day seemed to be an agreed maximum. Young adults did not come to a consensus on time of day to receive messages and this varied from 7am-12am. Young adults agreed that contact should be individualized and positive. Text messages cannot be automated messages and need to come from a person who acts as a health coach or motivator to the individual. It is clear from the results of this study that young adults need to have the ability to choose the amount of messages they wish to receive per day and they should also choose the method (email or text) as well. Also, when working with young adults, monitoring of their food and exercise should be used as a way to form motivational messages to send, this way the messages are more personal and directly relate to their daily habits. This way, the young adult stays engaged and is receiving the type of contact that will best help them reach their goals.

Conclusion:

This focus group study explored the young adult's opinion on overweight/obesity, counseling for weight loss, and the use of smartphone technology. It is clear from the study that young adults who are interested in weight loss are open and excited about using applications. Although young adults do not know about specific technology that exists, they are open to learning this technology as long as it fits into their lifestyle.

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Table 1: Discussion Guide Questions				
Topic	**Opening Question**	**Follow-up question**	**Follow-up question**	**Follow-up question**
General feelings on overweight/ obesity in young adults	I would like to hear about your thoughts on overweight and obesity in the young adults.	Have you ever heard that college is a time where people gain weight?	Do you know many people your own age who are trying to lose weight?	How healthy do you think young adults are in general
Counseling Session	I would like to hear your thoughts on what types of information you would want to discuss with someone if you were trying to lose weight.	Can you describe what you think about exercise when it comes to losing weight?	What are your thoughts on sugar-sweetened beverages and weight loss?	Do you see eating breakfast as something important for a person trying to lose weight? Please explain.
Smartphone Application/ Text and Email Contact	What types of things would you want a Smartphone application to have to help you lose weight?	How would you feel about messages to help keep you on track?	What types of messages would keep you motivated? Can you give an example of what one might say?	What do you think is a good amount of messages? How many messages would you want to receive?

Table 2: Take Home Messages

Take Home Messages
• Young adults are excited to use applications to help them lose weight • Young adults often gain weight due to freedom to make food choices • Time is a priority and often competes with weight loss • Messages should contain individual feedback • Motivational and positive feedback messages are preferred • An application that is all-inclusive is desired

CHAPTER FOUR: MANUSCRIPT THREE

Smartphone Technology and Text Messaging for Weight Loss in Young Adults: A Randomized Controlled Trial

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Abstract

Objective: Smartphone technology and text messaging for health is a growing field. This type of technology is well integrated into the lives of young adults. However, few studies have tested the effect of this type of technology to promote weight loss in young adults

Methods: Sixty-two young adults, aged 18-25 years, were randomized to receive: 1) a Smartphone application + health coach intervention and counseling session or 2) control condition with a counseling session. All outcomes measures were tested at baseline and 3 months. These included weight, BMI, waist circumference, dietary habits, physical activity habits, and self-efficacy for healthy eating and physical activity.

Results: The sample was 71% female and 39% white, with an average age of 20 years and average BMI of 28.5kg/m^2. Participants in the Smartphone + health coach group lost significantly more weight ($p=0.026$) and had a significant reduction in both BMI ($p=0.024$) and waist circumference ($p<0.01$) compared to controls.

Conclusions: The results of this weight loss trial support the use of Smartphone technology and feedback from a health coach on improving weight in a group of diverse young adults.

Keywords: Smartphone, Obesity, Overweight, Intervention, Behavior Modification

Introduction

Overweight and obesity are a major public health concern in the United States (US). More than one-half of US adults (60.3%) aged 20-39 years are considered overweight or obese with a body mass index ≥ 25. (1) Weight gain is specifically a concern in college-aged individuals. Although the common theory that college freshman gain 15 pounds has been disproven on most accounts (2), studies have shown that many students do in fact gain weight during their first year of college (3-4). Being overweight or obese greatly increases one's risk for stroke, heart disease, type 2 diabetes, and some forms of cancer (5). Therefore, interventions to combat weight gain during these years are needed and important for healthy outcomes later in life.

The behaviors of college-aged individuals put them at risk for weight gain. Specifically, poor eating habits, eating high calorie foods, decreased physical activity, decreased fruit and vegetable consumption and increased alcohol consumption all contribute to weight gain (6-7).

Technology is well integrated into the lives of young adults. Currently, 85% of young adults, aged 18-29 years, own a Smartphone. Among those young adults, 100% use their smartphone to send and receive text messages (8). Additionally, 97% of young adults use their Smartphone to browse the Internet, and 77% of young adults have used their Smartphone to look up health information (8). A recent focus group study conducted by the first author identified that young adults are interested in utilizing Smartphone technology for weight loss, although very little is currently known about different applications for weight loss (9).

Interventions for weight loss in this population have proven to be successful using various strategies. One study utilized a social networking site and text messaging and showed greater weight loss in the group that received both the social networking intervention and text messages (-2.4kg) compared to the social networking site alone (-0.63kg) (10). Another study utilizing the Internet reported increased fruit and vegetable consumption, although no differences in weight were noted (11).

Smartphone technology can provide an individual with the ability to self-monitor diet and physical activity; receive feedback through the application or text messaging, and track progress towards goals. However, there is limited knowledge on the use of Smartphone technology for weight loss in young adults. Therefore, the purpose of this study was to test the effectiveness of a behaviorally-based Smartphone application focusing on energy balance combined with text messaging from a health coach on weight loss in young adults as compared to a group only receiving one brief counseling session.

Methods

The Young Adult Weight Loss Study (YAWL) was a randomized, controlled trial in which participants were randomly assigned to intervention or control. Assessments were completed at baseline and 3 months between 2014-2015. All participants provided informed written consent. The protocol was approved by the Johns Hopkins University Institutional Review Board. Study data were collected via paper/pencil questionnaires and a web-based program for dietary recall. The Research Electronic Data Capture (REDCap), a secure, web-based application, was used to store data.

Setting and Participants: Participants were recruited using a variety of strategies including posters/flyers, Facebook, email announcements, and word of mouth. These methods were used in and around the Johns Hopkins University campuses. Individuals between 18-25 years of age with a body mass index (BMI) between 25-40kg/m2 who owned an iPhone or Android phone were eligible to participate. Participants were excluded if they were currently participating in another structured weight loss program, were taking weight loss medications, had been diagnosed with Type I diabetes, or currently pregnant or planning to become pregnant in the next 3 months. Individuals were also excluded if they currently exercised more than 150 minutes per week at moderate intensity, or have had symptoms of disordered eating in the previous 6 months.
Screening and Randomization: Interested individuals were encouraged through recruiting materials to contact the primary investigator by phone or email to set up a telephone screening. The primary investigator completed the telephone screening and if the individual qualified, they were asked to set-up a baseline visit. Written consent was obtained at the baseline visit. Randomization occurred after data were collected at the baseline visit. Participants were randomly assigned by blocks of 4 to the intervention or control groups. The block sequence was generated using a computer randomization scheme. At the 3-month follow-up, individuals in the control group received the Smartphone application. All participants received a $25 gift card for participation in the study.

Outcome measures: Data on the outcome measures and lifestyle behaviors were collected on all participants at baseline and 3 months. Body weight was measured using

the Tanita BS-549 Ironman scale with the participant in light clothing. Height was measured using a wall stick measurement. BMI was then calculated using weight in kilograms/height in meters squared. Waist circumference was measured using a laminated tape measure two times and then averaged.

Physical activity was evaluated with the Godin Leisure-Time Exercise Questionnaire. The survey is self-administered and assesses strenuous, moderate, and mild activity over a 7-day period as well as assessing the time spent in activity long enough to workup a sweat. (12) This survey method has been proven to be both valid and reliable when measuring moderate and intense physical activity in adults. (13) Nutrition data was collected using the National Cancer Institute's ASA-24. The ASA-24 is a web-based, automated self-administered 24-hour recall of foods and was filled out on the participant's computer. The ASA-24 provides analysis on calories, nutrients, and food group estimates. (14) It has been proven to be reliable and valid in an adult population, with the ASA-24 performing very close to standardized interviewer-administered 24-hour food recalls. (14)

Self-efficacy for healthy eating and exercise were evaluated with two questionnaires. The Self Efficacy for Healthy Eating scale was self-administered by the participant. This was a 13-item questionnaire that explores a person's belief in their ability to make better food choices in given situations. A reliability coefficient of 0.87 indicated high internal consistency on the scale tested in a large group of men and women, ages 19-64 years. (15) Self-efficacy for physical activity was assessed using a 14-item questionnaire called the Self-Efficacy for Exercise Scale that was self-

administered. This 14-item questionnaire assessed an individual's belief in their ability to perform physical activity in given situations. Both self-efficacy questionnaires were scored on an 11-point scale ranging from not at all confident (0) to extremely confident (10). This scale was determined to be reliable and valid in a population of adults, with an internal consistency of 0.90 and a test-retest correlation was 0.67. (16)

Interventions: The behavioral intervention was based primarily on social cognitive theory (SCT) and self-efficacy theory, which were used in our prior pilot study. (17) The theories guided the intervention, which focused on increasing the participant's self-efficacy to achieve better health outcomes related to weight loss. The goals for both groups were to lose 1-2 pounds per week and increase minutes in physical activity performed. Both groups received a one-time counseling session prior to randomization. This counseling session was a brief, 20-minute session that discussed healthy eating, portion control, limiting alcohol and sugar sweetened beverages, increasing physical activity, and overcoming barriers. Following this session, participants were randomized to one of two groups, control or Smartphone + Health Coach (intervention) for the three month study period. Individuals randomized to the intervention group were assisted in downloading the Smartphone application and also received an additional counseling session, which took place following the instructions on how to use the application.

Smartphone +Health Coach Group: The behavioral intervention was driven by SCT and self-efficacy theory. SCT states there are four ways to increase one's self-efficacy; mastery experience, social modeling, social support, and verbal persuasion. (18)

The first three concepts were all achieved through an additional counseling

session and by use of a commercially available Smartphone application called Lose It! Participants in the intervention group were given an additional 30-40 minute counseling session on energy balance, nutrient density of foods, sugar-sweetened beverage consumption, including alcohol and physical activity. Participants were encouraged during this session to identify specific goals that their health coach could help them achieve when being coached.

Participants were encouraged to enter all foods consumed and exercised performed into the daily log in the application. They were instructed to follow the caloric budget set by the application using the Mifflin equation. Tracking and monitoring of their diet and physical activity allowed the users to track and monitor their own progress. The application also addressed the concept of social modeling by offering social networking through a "friend" feature, which allowed individuals to view peer weight loss and physical activity participation, the ability to see others achieving goals and making progress, and also allowed the interaction between peers to encourage one another on their goals. Participants were encouraged to use this feature. The participants also had the ability to set up daily reminders and motivators, which allowed for further individualization of the program.

The concept of verbal persuasion was achieved through individualized text messages delivered to the participant's Smartphone. These messages were not push and pull, meaning that participants were asked to not text their health coach. Based on data from a focus group study conducted by the first author, the participants could choose any frequency of messages they wanted to receive from a health coach, anywhere from 1 time

per week up to 3 times per day. (9) The Smartphone application used provided the health coach with the ability to monitor and track all participant progress on a real-time basis. This feature made it possible to send real-time individualized text messages to each participant. Texts were sent from the health coach's cell phone at the specified time and frequency of the participant.

Control Group: The control group was asked to not download or utilize any Smartphone applications focused on weight loss for the duration of the study. They received the Lose It! application with a training session at their final 3-month visit.

Statistical Analysis: The study was powered to detect statistically significant differences in weight loss between the two groups. Using an effect size of 0.8, calculated from a similar study (10), an alpha of 0.05, and a power of 80%, the sample size was determined to be 51. The sample size was increased by 15% to allow for attrition, to give a total sample size of 60, or 30 per group. Group differences in baseline sociodemographic and anthropometric characteristics were examined using Wilcoxin rank-sum tests and chi-squared or Fisher's Exact tests. The primary outcomes were changes from baseline to three months in weight in kilograms, BMI and waist circumference in centimeters. Secondary outcomes were changes in diet, physical activity, and self-efficacy for diet and physical activity. A completers analysis was performed using generalized linear models, which were used to test for group differences, time effects, and interactions between group*time. All statistical analyses were done using Statistical Analysis System (SAS).

Results

Baseline Characteristics: Baseline characteristics of participants by group are shown in Table 1. Of the 62 participants enrolled, 71% were female, 33.8% were Asian, and 12.9% were African American. The overall median age was 20.0 (18.0-25.0) years and median BMI was 28.5 (25.0-40.4). There were no significant differences in baseline characteristics between the two groups.

Recruitment and Retention: Figure 1 is the CONSORT diagram reporting the participant flow through the study. We assessed 87 individuals for eligibility.

A total of 66 individuals met the criteria to participate. Of those, 4 (6%) declined to participate. The primary reason for refusal was lack of interest in participating in a study for 3 months. A total of 62 individuals were randomized to one of the two groups, which represented 71% of those who originally expressed interest in participating.

Fifty-nine (95%) returned at three months for follow-up measurements. Retention rates were similar in the two groups, 97% in the control group and 94% in the intervention group.

Weight, BMI, and Waist Circumference: Changes from baseline to 3 months can be found in Table 2. The control group gained a slight amount of weight from baseline to 3 months (79.8 kg vs. 80.1 kg), while participants in the Smartphone group lost a significant amount (83.8kg vs. 82.0 kg, $p<0.01$); the difference in weight change between groups was statistically significant ($p=0.026$). The Smartphone group also had a significant decrease in BMI ($p<0.01$) and waist circumference ($p<0.01$). The differences

in BMI and waist circumference changes between groups were also statistically significant ($p=0.024$ for BMI, $p<0.01$ for waist circumference).

Self-Reported Behaviors: Changes in self-reported behaviors can also be found in Table 2. Change in nutrition knowledge scores did not differ significantly between the two groups. However, it is interesting to note that the control group did improve their nutrition knowledge significantly over the 3 months ($p=0.013$). The intervention group improved significantly in both healthy eating self-efficacy ($p=0.032$) and overall physical activity performed ($p<0.01$), however, the differences were not significant when compared to the control group. Although both groups showed improvement in self-efficacy for physical activity, neither change was statistically significant. A comparison of degree of change between groups was also performed (Group*Time Interaction with All Subjects) adjusting for self-efficacy for healthy eating and exercise. When adjusting for self-efficacy for healthy eating, the data show that it is a slight mediator for change in weight with a p value shifting from $p=0.026$ for non-adjusted to $p=0.052$ when adjusted. Tests were also run for BMI and waist circumference, but there was no shift in p value, suggesting that self-efficacy for healthy eating does not entirely account for the treatment group effect.

A total of 37 participants completed the diet questionnaire at follow-up (22 control and 15 smartphone + health coach). The diet analysis showed no significant differences between the two groups at follow-up. However, it is interesting to note that participants in the intervention group consumed more fiber, more protein, more

vegetables, more fruit, fewer total carbohydrates, and fewer added sugars than participants in the control arm.

Application Use and Text Messaging

The number of text messages sent varied from 1 per day to 3 times per day. No participants requested less than one message per day. Overall, 71% of the intervention group requested 3 messages per day, 13% requested two messages per day, and 16% requested 1 message per day. All text messages were delivered to participants successfully and no issues were mentioned.

All participants assigned to the intervention group logged both exercise and diet. Over the three month time period, 21% of participants logged exercise on > 50% of days and 62% logged diet on > 50% of days. Of those participants that logged diet more than 50% of the time in the study, 38% logged diet on >75% of days. There was a significant relationship between number of physical activity days logged and weight loss (0.03 kg weight loss per additional day of PA logging, p=0.026). The 6 participants who logged PA > 50% of the time lost 1.57 kg more than those who did not. When the threshold was reduced to 25% days logged, the 9 participants logging PA ≥25% of the time lost 1.43 kg more than those logging PA < 25% of the time. The same directional trends were observed with increased logging frequency for food, as well, but these were not significant (p=0.226), possibly due to overall good compliance with food logging.

Discussion

To date, to the authors' knowledge, this is the first trial focused on young adults that utilized both individualized text messages and a Smartphone application for weight loss.

This randomized trial showed that the use of a Smartphone application for weight loss combined with individualized text messages is successful in helping individuals to lose weight. Individuals in the intervention group lost significantly more weight than those in the control group, had a significant decrease in BMI when compared to the control group, and significantly decreased their waist circumference compared to the control group.

Self-reported nutrition intake and self-reported self-efficacy did not differ significantly between groups. Although it is noteworthy that self-efficacy did increase significantly for healthy eating ($p=0.03$) in the intervention group and both groups experienced an increase in self-efficacy for exercise, although this was not significant. Self reported physical activity using a 7-day recall significantly increased in the intervention group ($p<0.01$) although the difference was not significant when compared to the control group.

An increase in logging into the Smartphone application for both physical activity and diet led to better outcomes with weight loss. It is therefore important that compliance with logging be a focus in future interventions, whether it is stressed during a counseling session or more frequent reminders are sent to participant phones.

There are several strengths to note in this study. Strengths of the study include the randomized design powered to detect significant differences between groups, use of a commercially available Smartphone application, and an attrition rate of only 5%.

Study limitations include the small sample size and limited generalizability of the study population in that most were attending college at a single university on the east

coast. However, it is noteworthy that >60% of the study population was from a minority group.

Conclusion

This randomized controlled trial using a Smartphone application for weight loss combined with individualized text messages has provided valuable information that the combination of self-monitoring via an application and feedback from a health coach is successful in helping young adults lose weight. The study had a meaningful impact on weight, BMI, and waist circumference. The intervention may need to be strengthened to focus more on the nutrient density of foods and to assist young adults in making overall healthier food choices. In future trials, a sample that includes both those individuals attending college and those not attending college could strengthen the generalizability of the results. Smartphone technology (both applications and text messaging) seems to be an appropriate resource to utilize when working with the young adult population and it has the potential to greatly impact the serious public health problem of obesity.

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Figure 1: Study Flow Diagram

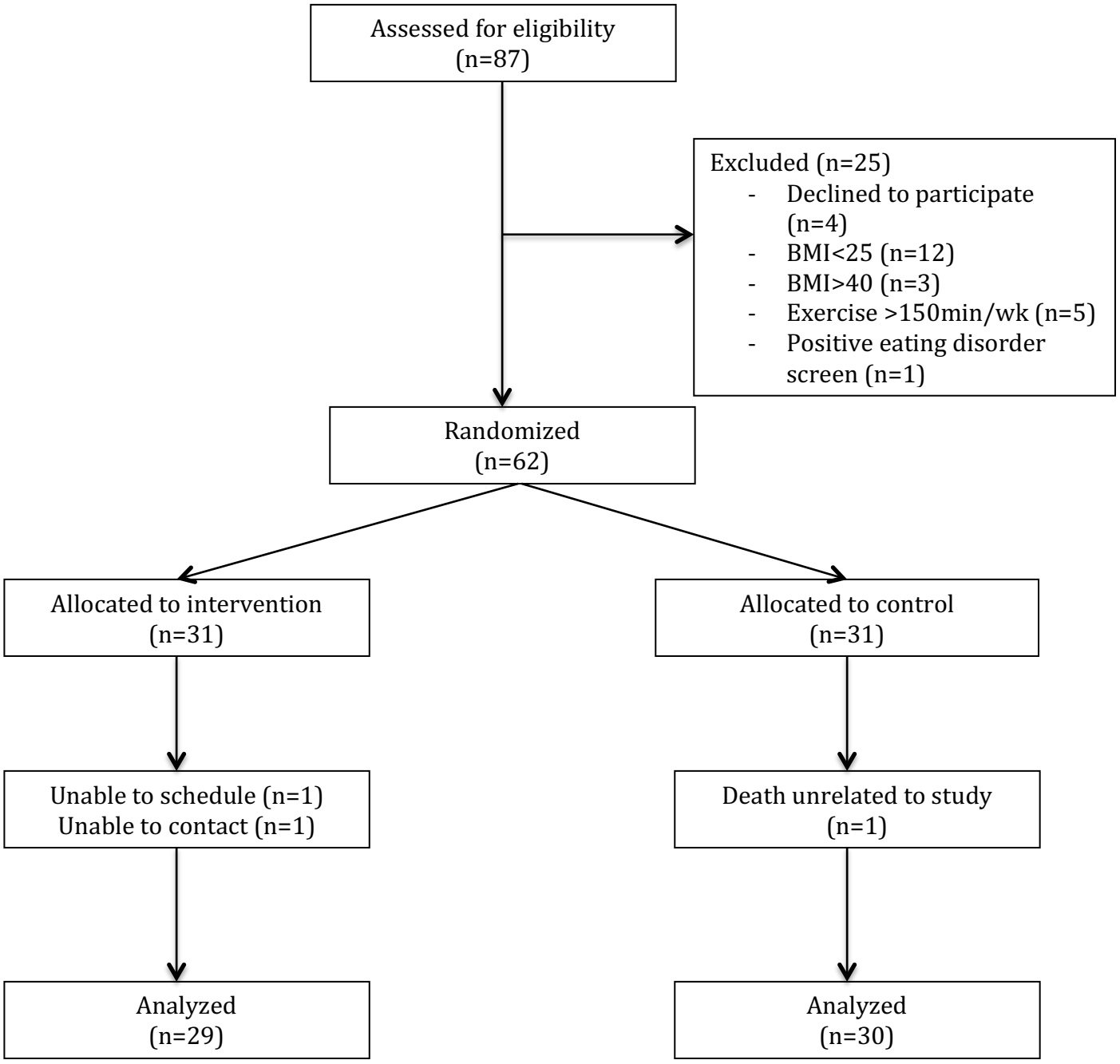

Table 1. Baseline Sample Characteristics by Treatment Group				
Characteristics	Total	Control	Smartphone + Health Coach	P value
n	62	31	31	
Age, years, median (range)	20.0 (18.0-25.0)	20.0 (18.0-24.0)	20.0 (18.0-25.0)	1
Race, n (%)	-------	-------	-------	0.7917
White	24 (38.7)	12 (38.7)	12 (38.7)	
Black	8 (12.9)	5 (16.1)	3 (9.7)	
Asian	21 (33.8)	9 (29.0)	12 (38.7)	
Other	9 (14.5)	5 (16.1)	4 (12.9)	
Sex, n (%)	-------	-------	-------	0.6322
Male	18 (29.0)	8 (25.8)	10 (32.3)	
Female	44 (71.0)	22 (71.0)	21 (67.7)	.
BMI, kg/m^2, median (range)	28.5 (25.0-40.4)	26.6 (25.0-39.7)	29.0 (25.2-40.4)	0.0898
Waist Circumference, cm, median (range)	93.8 (81.0-120.0)	93.5 (81.0-120.0)	95.8 (82.5-120.0)	0.294
Type Of Smartphone	-------	-------	-------	0.3493
iPhone	49 (79.0)	23 (74.2)	26 (83.9)	
Android Phone	13 (21.0)	8 (25.8)	5 (16.1)	

BMI: Body mass index

Table 2: PRE- and POST- Intervention Measurements of Body Size and Self-Reported Behaviors							
	Control			Smartphone + Health Coach			
Body Size	PRE	POST	P[1]	PRE	POST	P[2]	P[3]
Weight, kg, mean, SD	79.8 ± 11.7	80.1 ± 11.5	0.764	83.8 ± 14.7	82.0 ± 14.9	<0.01	0.026
BMI, kg/m^2, mean, SD	28.5 ± 3.4	28.6 ± 3.3	0.811	30.2 ± 3.6	29.2 ± 3.81	<0.01	0.024
Waist Circumference, cm, mean, SD	94.4 ± 9.41	94.4 ± 8.6	0.964	97.8 ± 11.3	94.1 ± 11.8	<0.01	<0.01
Nutrition Knowledge, median, range	27.5 (17-35)	29 (21-34)	0.013	30 (22-34)	29 (22-36)	0.771	0.068
Self-Efficacy (Healthy Eating), median, range	102 (60-130)	109 (77-130)	0.273	100 (66-120)	106 (73-128)	0.032	0.190
Physical Activity, 7 Day Recall, median, range	34 (3-108.5)	36 (6.0-92)	0.099	32 (0-72)	43 (15-81)	<0.01	0.503
Self-Efficacy (Exercise), median, range	87.5 (54-131)	92 (42-124)	0.258	86 (25-127)	97 (30-140)	0.151	0.541

*Variables summarized as median (range) and compared from PRE-POST using Wilcoxon rank-sum test; between group interaction tested using repeated-measures ANOVA

1. Comparison of POST vs. PRE in Control group (Group effect in GLM for Control only)
2. Comparison of POST vs. PRE in Smartphone group (Group effect in GLM for Treated only)
3. Comparison of degree of change between groups (Group*Time Interaction with All Subjects)

CHAPTER FIVE: DISCUSSION

Introduction

In this chapter, the results of the study are summarized. The main findings from the focus group study and randomized controlled trial are organized by study aim. Following the findings summary, the strengths and limitations are discussed. Also, implications and recommendations for future research are discussed.

Main Findings

Focus Group Study

Aim 1: Explore a young adult's perspective on nutrition, exercise, and technology for weight loss in order to design a randomized controlled trial.

This focus group study was designed to explore the young adult's perspective on general nutrition, physical activity, and the use of Smartphone technology to combat overweight and obesity. Five major themes emerged from the data collected: Freedom to choose often equals overweight and obesity, priorities are key, squash the rumors and talk with an expert, give me an app that does it all, and personalize all messages or risk being ignored.

Findings suggested that young adults had difficulty making healthy food choices. Specifically, the freedom to choose foods without parental influence played a large role in the unhealthy choices they were making. Also, the amount of food available in college cafeterias is limitless, as many students reported that they had an unlimited meal plan. Alcohol consumption was also a contributor to weight gain in this population, as drinking was reported to occur during the week as well as the weekends. It was even reported that knowledge related to healthy food choices was limited and that education was needed on calories and nutrients in foods.

Young adults reported that competing priorities got in the way of making healthy food choices. When a young adult had another priority, such as studying or sleeping, they would choose fast and convenient foods to each, which were generally unhealthy choices. Also, priorities stood in the way of exercise, as many students reported being too busy with classes to take the time to exercise.

Young adults expressed great interest in talking with an expert about nutrition and physical activity. Much of what they knew about these subjects came from the Internet or social media and this information was not trusted as much as they would like. It was important then to speak with someone with knowledge who could also help them set short-term and long-term goals.

One important finding was that knowledge is limited on Smartphone applications designed to help young adults lose weight. Many suggested they had heard of applications, but were not sure how they worked or what features they had. There was great interest in using applications for the purpose of weight loss, but they needed more direction in this area.

Finally, young adults expressed interest in receiving text messages from a health coach. All expressed that it was vital to have any message be personalized to an individual and that any general messages were likely to be ignored. There was no consensus on the amount of messages that young adults would like to receive from a person like a health coach. Answers ranged from one time a week to multiple times per day.

These findings suggested that Smartphone applications and text messaging for weight loss would be a desirable intervention in this population. From this information, a randomized controlled trial was designed. The intervention took into account what was expressed across the focus groups. The intervention was designed to have a counseling session, which would focus on healthy eating, physical activity, motivations for weight loss, and setting goals. A person who had extensive knowledge in these subject areas would deliver the counseling session. Further, the information gathered in the focus groups shaped the technology piece of the intervention. Taking into account what was expressed, the intervention was designed to allow young adults to choose the frequency of text messages they received from a health coach. Also, due to the lack of knowledge regarding the use of Smartphone applications for weight loss, a training session on use of the application was added as part of the intervention.

Randomized Controlled Trial

Aim 2: To determine if young adults in a Smartphone + health coach group will have a significantly greater weight loss compared to those in a control group.

The Smartphone + health coach group lost significantly more weight than the control group (-2.7kg vs. +1.5kg, $p=0.026$). The intervention group also had a significant decrease in BMI (-1.4 vs. -0.3, $p=0.024$) and waist circumference (-3.5cm vs. -1.0cm, $p<0.01$) compared to control. Examining the Smartphone + health coach group alone also showed significant reductions for weight ($p<0.01$), BMI ($p<0.01$) and waist circumference ($p<0.01$). The control group did not have any significant increases or decreases in body measurements.

Aim 3: To determine if young adults in a Smartphone + health coach group will have a significantly greater increase in total physical activity performed compared to those in a control group.

The Smartphone + health coach group and the control group both had increases in total physical activity self-reported over a 7 day period. The Smartphone + health coach group was the only group that had significant improvement in scores, by increasing total activity score, on average, by 11 points ($p>0.01$). Although the control group increased by an average of 2 points, this increase was not significant ($p=0.099$). The examination of degree of change between groups was not significant for total physical activity ($p=0.503$).

Aim 4: To determine if young adults in a Smartphone + health coach group will have a significantly greater increase in healthy eating habits compared to those in a control group.

There were no significant changes in healthy eating habits over the 3-month period. The healthy eating habits included improvements in fiber consumption, fruit and vegetable servings, protein, and consuming less added sugars. The participants in the Smartphone + health coach group did consume more fiber (18.4g vs. 13.0g), more protein (78g vs. 59g), more fruits (1c vs. 0.5c) and vegetables (1.2c vs. 1c), less total carbohydrates (170g vs. 177g), and fewer added sugars (5.6tsp vs. 8.2tsp) than those in the control arm, although none of these improvements were statistically significant. Although the results were not shown to be statistically significant, it is important to note that increases in fruit and vegetable consumption as well as increased fiber consumption has been shown to be protective from coronary heart disease in some individuals. (1,2)

It is important to note that only 37 participants completed the dietary analysis at follow-up (22 control and 15 Smartphone + health coach) therefore the study was not powered to detect statistically significant differences between the two groups.

Aim 5: To determine if young adults in a Smartphone + health coach group will have a significantly greater increase in self-efficacy for healthy eating and physical activity compared to those in a control group.

Self-efficacy for healthy eating significant increased in the control group (p=0.03) with scores, on average, increasing by 6 points. The control group also showed improvement in scores, but this change was not significant (p=0.273). The difference between the two groups was not significant (p=0.190).

Self-efficacy for exercise also improved in both groups, although neither improvement in score was significant. The control group's scores for self-efficacy for exercise improved on average by 4.5 points (p=0.258) and the Smartphone + health coach group's scores improved, on average, by 9 points (p=0.151).

An additional analysis was performed to determine if self-efficacy for exercise or healthy eating was acting as a mediator for weight loss. When adjusting for self-efficacy for healthy eating, the data show that it was a slight mediator for change in weight with a p value shifting from p=0.026 for non-adjusted to p=0.052 when adjusted. Tests were also run for BMI and waist circumference, but there was no shift in p value, suggesting that self-efficacy for healthy eating does not mediate the treatment group effect.

Summary of Results

From the results reported above, it is clear that utilizing Smartphone technology in combination with a counseling session and personalized text messages can help young adults lose weight. It is still unclear whether the intervention had an impact on self-efficacy or if being in a study alone, even without intervention, can increase one's self-efficacy for healthy eating and exercise. The results also suggest that joining a weight loss study, regardless of group randomization, may lead to increased nutrition knowledge. Young adults who are driven to join a weight loss study may already be motivated to change their eating habits and exercise patterns, thus leading to a focus on nutrition and increased nutritional knowledge regardless of intervention received. It is also possible that the brief, one time counseling session delivered to both groups impacted overall nutrition knowledge enough to raise scores on the questionnaire used in the study. It is clear from the results that self-monitoring through logging was a key part of the intervention and future research should focus on engagement strategies to encourage more compliance with logging.

Strengths and Limitations

This dissertation study had numerous strengths. One strength was the focus group study that was conducted to better understand the young adult population and their needs in terms of using Smartphone technology for weight loss. Conducting the qualitative study allowed for a stronger intervention design that likely helped lead to the positive outcomes in the main study.

Another strength was the minimal attrition in the main study. Out of 62 total participants that were randomized to receive intervention or control, 59 returned at

follow-up. That is an attrition rate of less than 5%, which is ideal when examining outcomes at two time points.

A third strength included the diversity of the study population in terms of race. The study was predominately minority, with only 38.7% participants identifying as white. A total of 33.8% of the study participants were Asian, which is a group that is often not studied in weight loss trials. In addition to that, 13% of the study population was African American.

The limitations of the study include the fact that recruitment was primarily conducted in a single university setting, which could limit the generalizability of the results. Future trials should aim to recruit from non-university settings to diversify the study population. Another limitation of the study was that participants were required to have a Smartphone to join. Although most young adults do own a Smartphone, there is still a percentage of the population that does not and therefore they were not eligible to participate.

In additions to the limitations noted above, another major limitation to the study was the self-reported nature of the participant's behaviors, which could possibly lead to measurement error. All dietary information and physical activity information were self-reported. In order to most accurately assess dietary information and physical activity information, a method more stringent than self-report should be utilized. For example, combination of instruments for self-reporting diet is one method that may help to reduce bias and improve precision. Or, utilizing an exercise monitor that accounts for

participant's activity levels (measuring exercise) may help to combat bias of self-reported activity.

Further, this study was only a 3-month intervention. Within this time frame, there is not enough time to understand weight maintenance and if young adults would continue to utilize this type of technology and keep the weight off they had lost during the intervention period. It is recommended that future studies carry out a longer trial and build in a weight maintenance phase of the intervention following the weight loss phase.

Implications/Dissemination of Findings

As adolescents enter adulthood, weight gain is common. Interventions that utilize technologies that are integrated into the lives of young adults are necessary to help combat the ongoing obesity problem. This study showed that the utilization of a behaviorally based Smartphone application for weight loss combined with personalized text messages could help young adults lose weight, reduce their BMI, and decrease their waist circumference. This type of intervention may also to increase physical activity levels. This study should be replicated in larger, more diverse populations to replicate results.

Nursing Implications

Since overweight and obesity are such a large problem in young adults, clinicians should be assessing body mass index of all patients in this age range. Upon informing patients of their BMI, a brief counseling session should be conducted that encourages healthier eating, cutting back on sugar-sweetened beverages, modes for increasing exercise, and tools that are available to help with weight loss. Young adults should be

introduced to different forms of technology, such as Smartphone applications, that can be easily integrated into their lives. Nurses are particularly well positioned to educate young adults both on the serious implications of being overweight or obese and on different modes of possible treatment. Nurses who work in college-based clinics are front-line providers and can be very influential in terms of improving outcomes and overall health of young adults.

Recommendations for Future Research

This study supported the use of Smartphone technology and text messaging for weight loss in young adults. However, this intervention falls short in having total compliance with the intervention. Those that logged more frequently had greater outcomes related to weight loss. Therefore, future research should focus on engagement strategies to keep participants involved in daily logging or monitoring of their diet and physical activity.

Future research should focus on a broader group of young adults, so that the study results are more generalizable to the population. One area that may be of particular interest would be examining the use of Smartphone technology and text messaging in both college students and non-college students that are between the ages of 18-25. It would be critical to have a large enough sample size to compare the two groups to ensure that this type of intervention is effective for those in a college environment vs. a non-college environment.

In addition, future research should include an automated system for delivering individualized text messages to participants. It is unlikely that on a large scale, health

care providers could send individualized text messages to each of their patients or study participants. Therefore, development of an algorithm that can sync with both food logging data and exercise logging data and determine a message to be sent would be beneficial. The messages would remain real-time, individualized, and based on an individual's daily progress, but would be delivered through a system rather than by an individual.

Conclusions

This study found that a Smartphone application plus text messaging could help young adults to lose weight. The findings from this study suggest that young adults are willing and able to utilize this type of technology and that it can assist them in creating healthier habits. These findings support the need for future research in the area of Smartphone technology and text messaging to help combat the ongoing problem of overweight and obesity.

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APPENDICES

Appendix 1: Focus Group Discussion Guide

Introduction:

Thank you for agreeing to participate in this discussion group. The purpose of this group is to learn more about what young adults think about losing weight. We are interested in learning more about what you think would be helpful to young adults like you who want to lose weight and what types of information you think they might want to help them lose weight. We are also interested in hearing your thoughts and opinions on a weight loss intervention we are working on and if there are ways we could improve this intervention for an upcoming study.

Ground Rules:

There are a few ground rules before we get started. Your comments will be kept confidential. You do not have to answer any question or respond to any comment if you do not want to. Only first names will be used; you can write your name on the card in front of you. You may use a "made up" name if you wish. This session will be tape-recorded and only the names on the cards will be recorded on the tape. We ask that only one person speak at a time. Everyone is encouraged to speak and to share ideas and respond to each others' comments as well as addressing my questions. Please refrain from sharing your personal weight loss stories in this group. If there are specific questions you may have about your own personal weight loss, we can address those one on one after the group session has finished.

This session will last about one hour.

Does anyone have any questions before we begin?

Section One: General feelings on overweight/obesity in young adults

To get started, I would like to hear about your thoughts on overweight and obesity in the young adults. Do you think that overweight and obesity are issues in those who are 18-25?

Have you ever heard that college is a time where people gain weight?

Probe: ask about the "freshman 15" and what they think about whether or not there is any truth to it

How healthy do you think young adults are in general?

Probe: lots of exercise? Healthy choices in the cafes?

Do you know many people your own age who are trying to lose weight?

Probe: what types of things are they doing to lose weight? What do they say helps them? What challenges them?

Probe: when someone is trying to lose weight, is it something they openly discuss with you?

Section Two: Counseling Session

I would like to hear your thoughts on what types of information you would want to discuss with someone if you were trying to lose weight. For example, in the upcoming study, each individual will have a one-time session with me where they will learn general information about nutrition and physical activity. I would like to hear your thoughts on what types of information you would want to have at this type of session.

Let's start this by making a list of general topics you think are important to know if you were trying to lose weight.

Probe: Is there anything not on the list that you would want to know before you attempted to lose weight?

Probe: when you look at the list we created, what would you say is the most important topic to helping someone lose weight?

Probe: is there any information that you would not want to discuss with someone prior to losing weight?

Probe: Something that I was thinking of discussing in the session is the consumption of sugar-sweetened beverages (SSBs). What are your thoughts on SSBs and weight loss? How would students react to this?

Probe: Tell me what you know about SSBs. For example, research has shown that SSBs are a major source of calories for college students, do you find this to be true in your life and the lives of your friends?

Let's talk about breakfast and what role that plays in a weight loss program. In general, people who weigh more than others do not consume breakfast. Do you see eating breakfast as something important for a person trying to lose weight?

Probe: in general, where do most young adults consume breakfast in your opinion? (café or in dorms?) Are there healthy options available to students?

Can you describe what you think about exercise when it comes to losing weight?

Probe: what types of things do you want to know about exercise? How important do you think this is? Would young adults who are trying to lose weight be interested in hearing about exercise?

Section Three: Smartphone Application

As part of the study, some individuals will use a Smartphone application. What types of things would you want a Smartphone application to have to help you lose weight?

Probe: How about something that helped you track exactly what you were eating (calories)? Would you find this useful?

Also, the individuals will receive emails or text messages to help keep them motivated. How would you feel about messages to help keep you on track?

What do you think is a good amount of messages? How many messages would you want to receive?

What time of day would you want to get messages?

What types of messages would keep you motivated? Can you give an example of what one might say?

Section Four: General Questions

I want to show you some of the materials I plan to use to recruit for the study. (show materials) What do you think about these materials?

What changes should be made so that you would notice them more and want to respond?

I was thinking of beginning the study around the end of August/early September. Is this a time you think that young adults would be motivated to start losing weight?

Does anyone have any final thoughts on the topic of weight loss and what I am proposing to do that they would like to share?

Thank you for your time and contributions.

Appendix 2: Interview Forms

Healthy Eating Self-Efficacy

Record ID _____

11 point rating of confidence, from not at all confident (0) to extremely confident (10).

I can:

Choose fruit instead of donuts or pastries, most of the time, at coffee breaks. _____

eat at least 3 servings of vegetables every day. _____

choose a fruit salad or fresh fruit for dessert when eating in a cafeteria, most of the time, instead of cake or pie. _____

avoid preparing all deep-fried foods such as French fries, batter coated chicken and batter-coated fish. _____

choose whole-grain rolls and breads on a regular basis, instead of white rolls and breads. _____

buy "calorie-wise" dressings and "light" spreads, most of the time, instead of regular dressings and spreads. _____

always choose a single hamburger with no special sauces, rather than a double cheeseburger or "quarter-pounder" in a fast-food restaurant. _____

use only 2% milk or skim milk for drinking, rather than whole milk _____

remove the skin from chicken breasts before cooking, all of the time _____

substitute legume dishes (i.e., using kidney beans, chick peas, lentils) for meat, fish, and poultry entrees once a week _____

eat meat and potatoes without gravy, most of the time _____

switch from other milks to skim milk for drinking, and stick to it _____

choose barbequed, broiled, baked, roasted, poached, or steamed foods in a restaurant, instead of fried foods, all of the time _____

Total Score _____

Godin Leisure-Time Activity

Record ID _____

Godin Leisure Time Questions

STRENUOUS EXERCISE (HEART BEATS RAPIDLY) (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

_____
(Times per week)

MODERATE EXERCISE (NOT EXHAUSTING) (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

_____
(Times per week)

MILD EXERCISE (MINIMAL EFFORT) (e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)

_____
(Times per week)

Total Activity Score

_____
((9 × Strenuous) + (5 × Moderate) + (3 × Mild))

During a typical 7-Day period (a week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

◯ Often
◯ Sometimes
◯ Never/Rarely

Exercise Selfefficacy

Record ID _____

Fill out the following form based on a scale from 0-10 (see figure)

I can exercise....

When tired _____

During or following a personal crisis _____

When feeling depressed _____

When feeling anxious _____

During bad weather _____

When slightly sore from the last time I exercised _____

When on vacation _____

When there are competing interests (like my favorite TV show) _____

When I have a lot of work to do _____

When I haven't reached my exercise goal _____

when I don't receive support from my family and friends _____

When I have not exercised for a prolonged period of time _____

When I have no one to exercise with _____

When my schedule is hectic _____

When my exercise workout is not enjoyable _____

Total Score _____

Nutrition Knowledge

Record ID _____

1. Do you think these are high or low in added sugar? (check one box per food)

Bananas
☐ High
☐ Low
☐ Not sure

Unflavored yogurt
☐ High
☐ Low
☐ Not sure

Ice cream
☐ High
☐ Low
☐ Not sure

Ketchup
☐ High
☐ Low
☐ Not Sure

Fruit canned in natural juices
☐ High
☐ Low
☐ Not sure

2. Do you think these are high or low in fat? (check on box per food)

Pasta without sauce
☐ High
☐ Low
☐ Not sure

Cream Cheese
☐ High
☐ Low
☐ Not sure

Beans
☐ High
☐ Low
☐ Not sure

Lunch meat
☐ High
☐ Low
☐ Not sure

Honey
☐ High
☐ Low
☐ Not sure

Nuts
☐ High
☐ Low
☐ Not sure

Bread
☐ High
☐ Low
☐ Not sure

Cottage Cheese
☐ High
☐ Low
☐ Not sure

Margarine

- ☐ High
- ☐ Low
- ☐ Not sure

3. Do you think these are high or low in salt? (check one box per food)

Sausages

- ☐ High
- ☐ Low
- ☐ Not sure

Pasta

- ☐ High
- ☐ Low
- ☐ Not sure

Fish Sticks

- ☐ High
- ☐ Low
- ☐ Not sure

Red Meat

- ☐ High
- ☐ Low
- ☐ Not sure

Frozen vegetables

- ☐ High
- ☐ Low
- ☐ Not sure

Cheese

- ☐ High
- ☐ Low
- ☐ Not sure

4. Do you think these are high or low in fiber? (check on box per food)

Bran Flakes

- ☐ High
- ☐ Low
- ☐ Not sure

Bananas

- ☐ High
- ☐ Low
- ☐ Not sure

Eggs

- ☐ High
- ☐ Low
- ☐ Not sure

Red meat

- ☐ High
- ☐ Low
- ☐ Not sure

Broccoli

- ☐ High
- ☐ Low
- ☐ Not sure

Nuts

- ☐ High
- ☐ Low
- ☐ Not sure

Fish

- ☐ High
- ☐ Low
- ☐ Not sure

Baked potatoes with skin

- ☐ High
- ☐ Low
- ☐ Not sure

Chicken	☐ High ☐ Low ☐ Not sure
Beans	☐ High ☐ Low ☐ Not sure

5. Do you think these fatty foods are high or low in saturated fat? (check one box per food)

Fish	☐ High ☐ Low ☐ Not sure
Whole Milk	☐ High ☐ Low ☐ Not sure
Olive Oil	☐ High ☐ Low ☐ Not sure
Red Meat	☐ High ☐ Low ☐ Not sure
Sunflower seed butter	☐ High ☐ Low ☐ Not sure
Chocolate	☐ High ☐ Low ☐ Not sure

Additional Questions

6. Which would be the best choice for a high fiber meal? (check one)	☐ Grilled chicken and white rice ☐ Egg and bacon sandwich on white bread ☐ Oatmeal with berries ☐ Plain crackers and cottage cheese
7. If a person wanted to reduce the amount of fat in their diet, which would be the best choice? (check one)	☐ Grilled steak ☐ Grilled sausages ☐ Grilled Turkey ☐ Grilled pork chop
8. If a person wanted to reduce the amount of salt in their diet, which would be the best choice? (circle one)	☐ Ready made frozen lasagna ☐ Turkey sandwich with cheese ☐ Vegetable omelet ☐ Chicken fried rice
9. If a person wanted to reduce the amount of sugar in their diet, which would be the best snack choice? (circle one)	☐ Hard boiled eggs ☐ Dried figs and apples ☐ Small salad with ranch dressing ☐ Crackers with strawberry jam

Appendix 3: Example Text Messages

Self-Regulation/Mastery

1. Great job meeting your goal of walking 10,000 steps per day last week! Try reaching 12,000 steps per day this week
2. Way to go! You burned 500 calories every day this week! Challenge yourself to burn 600 per day next week!
3. You stayed under your calorie budget today! Keep up that healthy eating and you'll be under tomorrow!
4. You consumed 84 ounces of liquid today! Way to go! Try swapping one high calorie beverage tomorrow for water, to still reach your goal and stay under your budget!
5. Congratulations! You were only 100mg away from meeting your sodium goal! Try swapping a piece of fruit for one packaged food item to help lower your intake!

Social Modeling

1. Have a friend that is in really good shape? Ask them to take a walk or jog with you today!
2. Working out with a group can be fun and motivating! Reach out to friends today and do something you all enjoy!
3. Know someone who eats a stellar diet? Call them and ask for some healthy tips!

4. Have a close friend who is trying to lose weight? How can you work together to cut back on fast foods?

Improving Physical and Emotional States (fear = excitement)

1. See that calorie budget as a scary thing? Find fun, healthy foods to make it an exciting adventure!
2. Going for your first run? Don't be scared, challenge yourself to go as far as you can!
3. Eating healthy each day can be tough. Think of it as an exciting challenge to beat each day!

Verbal Persuasion

1. I noticed you came very close to meeting your goal of 150 minutes of exercise last week. Great job! Let's work hard to meet that 150 minute goal this week
2. Want to keep the weight off you have already lost? Boost up your exercise routine to 40 minutes a day!
3. Did you know that people who skip breakfast tend to snack more during the day? Try eating a balanced breakfast each morning!
4. Excellent work meeting your dietary goal yesterday. Let's try to meet a new goal today and lower your sodium intake!
5. Drinking your calories does not provide a nutrient rich diet! Keep up the good work of drinking zero calorie beverages!

Curriculum Vitae
Janna Stephens
RN BSN PhD(c)

EDUCATION

PhD, Nursing **2010-Present**
Johns Hopkins University,
Baltimore, Maryland GPA 3.82
Dissertation Title: Young Adults and Weight Loss: A Randomized Controlled Trial
Mentor: Jerilyn Allen

2010-2012 – T32 Health Disparities Training Grant, Pre-doctoral fellow
Grant Number: 5T32NR007968-09 PI: Jerilyn Allen

2012-2013 – T32 Cardiovascular Research Training Grant, Pre-doctoral fellow
Grant Number: 1T32NR012704-01 PI: Jerilyn Allen

2013-2014 – T32 Diabetes and Obesity Training Grant, Pre-doctoral fellow
Grant number: 2T32DK062707-11A1 PI: Sherita Golden

2014-2015 – F31 Smartphone technology to decrease weight
Grant Number: F31 NR 013811 Sponsor: Jerilyn Allen

Bachelor of Science in Nursing, **June 2010**
University of Cincinnati,
Cincinnati Ohio GPA 3.8
2006-2007- Lindner Scholarship
2008-2009- Franz Scholarship
2009-2010- Fleischmann Scholarship

CURRENT LICENSE AND CERTIFICATION

2010, RN Maryland, R192779 **NOV 2015 Expires**

PROFESSIONAL EXPERIENCE

Research Nurse **8/2011-9/2012**
National Institute for Health
Bethesda MD

- Responsible for carrying out designated research protocols in the Radiology and Imaging Sciences Department
- Responsible for recruitment of healthy volunteers

Patient Care Assistant **06/2008-06/2010**
Cincinnati Children's Hospital Medical Center
Cincinnati OH

- Responsible for assessing and documenting patient vital signs, intake and output, transferring patients for procedures, holding and assisting with procedures, managed patient kitchen (including ordering food and budgeting finances)
- Member of the Shared Governance Team
- Hospital obtained Magnet Status
- Worked 20-30 hours per week

Student Researcher **07/2008-07/2009**
Cincinnati Genome Research Institute
Cincinnati OH

Projects Included:

2009- Sterol Metabolism during Pregnancy and Development
PI: Laura Woollett
Funding: NIH: Grant Number: 2R56HD034089-11A2

- Responsible for extracting, weighing, and measuring the fetuses
- Examined and measured cholesterol levels in dam and fetus
- Inputted data retrieved into database and interpreted data to report back to PI
- Helped to formulate new protocols and revise old protocols
- Worked 15-20 hours per week

2009- Apo AIV-Induced Satiety and HF Diet-Induced Obesity
PI: Patrick Tso
Funding: NIH: Grant Number: 5P01DK056863-090001

- Responsible for learning and understanding the mechanisms of ApoA IV
- Measuring the amount of ApoA IV found in tissues
- Interpreted data
- Presented data in monthly meetings
- Formulated new protocols and revised old protocols
- Worked 15-20 hours per week

2009- RNA Synthesis in the Liver
PI: Begoña Campos
Funding: NIH

- Performing animal studies to extract tissues for stabilization and purification of RNA
- Interpreting data and presenting data to PI

- Assisting in writing publications with PI
- Formulating new protocols
- Training new lab personnel
- Running tissue sample studies independently in lab
- Worked 15-20 hours per week

Grants:

Grant Number	Title	Dates
F31 NR 013811	Smartphone technology to decrease weight in young adults	1/2014-8/2015

PI: Janna Stephens
Sponsor: Jerilyn Allen

SCHOLARSHIP

Journal Articles

1. **Stephens JD**, Yager AM, Allen JK. Smartphone Technology and Text Messaging for Weight Loss in Young Adults: A Randomized Controlled Trial. *Journal of Cardiovascular Nursing.* Under Review.

2. **Stephens JD**, Moscou-Jackson G, Allen JK. Young adults, technology and weight loss: A focus group study. *Journal of Obesity*. 2015.

3. Allen JK, **Stephens JD**, Patel A. Technology-assisted weight management interventions: Systematic review of clinical trials. *Journal of Telemedicine and e-Health.* 2014;20(12):1103-1120.

4. Allen JK, **Stephens JD,** Dennison-Himmelfarb C, Stewart KJ, Hauck S. Randomized controlled pilot study testing the use of smartphone technology for obesity treatment. *Journal of Obesity.* 2013.

5. Azar KMJ, Lesser L, Laing BY, **Stephens J**, Aurora MS, Burke LE, Palaniappan LP. Theory-Based Content Analysis of Diet/Nutrition and Anthropometric Tracking Mobile Applications for Weight Management. *American Journal of Preventive Medicine*. 2013;45(5):583-589.

6. **Stephens J**, Allen JK. Mobile Phone Interventions to Reduce Cardiovascular Disease Risk Factors: A Systematic Review. *Journal of Cardiovascular Nursing*. 2013;28(4):320-329.

7. **Stephens J,** Allen JK, Dennison Himmelfarb CR. "Smart" coaching to promote physical activity, diet change, and cardiovascular disease. *Journal of Cardiovascular Nursing*. 2011;26(4):282-284.

Abstracts

1. **Stephens JD,** Allen JK. Young Adults, Technology and Weight Loss: A Focus Group Study. American Heart Association, Epi/Lifestyle Scientific Sessions. 2015.

2. **Stephens JD,** Allen JK. Randomized Controlled Pilot Study Testing the Use of Smartphone Technology for Obesity Treatment. Preventive Cardiovascular Nursing Association Annual Meeting. 2014.

3. Hayes AL, **Stephens JD**, Allen JK. Characterization of Sleep in Healthy Obese Participants Enrolled in a Weight Loss Intervention. SLEEP 2013 27th Annual Meeting of the Associated Professional Sleep Societies, LLC

4. Azar K, Lesser L, Laing B, **Stephens JD**. An evaluation of weight management apps in clinical practice: Room for improvement. American Public Health Association Annual Meeting 2013.

5. Nacif M, Ramon F, Gai N, Jones J, **Stephens JD**, Sibley C, Liu S, Bluemke D. Myocardial T1 Mapping and the Extracellular Volume Fraction (ECV) at 3 Tesla: Differences Between Gadobenate Dimeglumine and Gadofosveset Trisodium. RSNA Annual Meeting, 2012.

Presentations

1. **Stephens JD**. There's an app for that! International Society for Behavioral Nutrition and Physical Activity. Annual Meeting, 2014. Podium Presentation.

2. Allen JK, **Stephens JD**. Just a Phone Call Away: Mobile Apps for CVD Health. Preventive Cardiovascular Nursing Association, Annual Meeting 2014.

Radio Tour

Smartphone Use for Weight Loss in Children and Adolescents: 15 radio interviews across the country: over 4,000 airings.

PROFESSIONAL MEMBERSHIPS

The Obesity Society	**2013-Present**
Preventative Cardiovascular Nursing Association	**2010-present**

American Heart Association	**2010-present**
Prevention Science Committee, American Heart Association	**2013-2015**
CVN Prevention Committee, American Heart Association Appointment	**2011-2015**
Sigma Theta Tau, Nursing Honors Society	**2009-present**
Alpha Epsilon Delta, The National Health Pre-professional Honor Society	**2009-present**

EDUCATIONAL ACTIVITIES

Co-Investigator, Smart Coach for Cardiovascular Health, 2011-2014
Grant: Center for Behavior and Health, Johns Hopkins University
PI: Jerilyn Allen

- Responsible for aiding in formulating study design and specific aims
- Responsible for creating and submitting the consent form
- Responsible for aiding in the submission to the IRB
- Responsible for attending all meetings related to study
- Responsible for training nutritionists on using the technology in the study
- Responsible for training participants on using the technology in the study
- Creating a manual on use of the Smartphone application for study participants and co-investigators in the study
- Responsible for baseline screening and initial intervention visits for all participants
- Responsible for inputting data and interpreting data received throughout study
- Responsible for aiding in writing and submission of manuscript

Johns Hopkins School of Nursing- REDCap (Research Electronic Data Capture) Administrator, 2013-2014

- Responsible for training of new faculty and students on use of REDCap
- Act as the school "help desk" for all questions related to entering and storing data

Tutor for PhD students, PH 140.621-623, Statistical Methods in Public Health I, II, III, 2011-2012

Mentor for undergraduate nursing research honors students, Smart Coach Study, 2011-present.

Teaching Assistant:

Course Name	Date
NR.110.200.8201.FA14 Adult Health I	Fall 2014
NR.110.200.8101.SP14 Nutrition	Spring 2014
NR.110.200.8201.SP14 Nutrition	Spring 2014
NR.110.200.8301.SP14 Nutrition	Spring 2014

NR.110.201.8301.SP14 Human Growth and Development through the Lifespan	Spring 2014
NR.110.315.0101.SP14 Nursing for Adult Health I	Spring 2014
• Lecturer, Study Sessions, Exam Preparation/Review	
NR.110.315.0201.SP14 Nursing for Adult Health I	Spring 2014
• Lecturer, Study Sessions, Exam Preparation/Review	
NR.110.200.8101.FA13 Nutrition	Fall 2013
NR.110.200.8201.FA13 Nutrition	Fall 2013
NR.110.315.0101.FA13 Nursing for Adult Health I	Fall 2013
• Lecturer, Study Sessions, Exam Preparation/Review	
NR.110.315.0201.FA13 Nursing for Adult Health I	Fall 2013
• Lecturer, Study Sessions, Exam Preparation/Review	
NR.110.200.8101.SU13 Nutrition	Summer 2013
NR.110.313.0101.SU13 Principles of Pathophysiology	Summer 2013
NR.110.200.8101.SP13 Nutrition	Spring 2013
NR.110.405.0101.SP12 Public Health Nursing	Spring 2012
NR.110.405.0201.SP12 Public Health Nursing	Spring 2012
NR.110.507.0101.SP11 Statistical Literacy and Reasoning in Nursing Research	Spring 2011

Course Instructor:

Course Name	Date
NR.110.200.8101.SU14 Nutrition	Summer 2014
NR.110.200.8101.FA14 Nutrition	Fall 2014
NR.110.204.8101.FA14 Anatomy with Lab	Fall 2014
NR.110.205.8101.FA14 Physiology with Lab	Fall 2014
NR.110.200.0801.SP15 Nutrition	Spring 2015
NR.110.204.8101.SP15 Anatomy with Lab	Spring 2015
NR.110.205.8101.SP15 Physiology with Lab	Spring 2015